THE

ELECTRICAL REVIEW.

VOL. XLV. AUGUST 25, 1899. No. 1,135.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1899

Edition

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THE INDUSTRIAL DEADLOCK.

ATTENTION has been drawn recently in these columns to the difficulties that beset the electrical industry in being unable to cope with the constant stream of orders that is flowing in. There are some philosophers who maintain that to have a plethora of orders is almost as bad as having none. Probably there is a certain amount of truth in the assertion, but there is this marked difference, when a man has no orders he may be credited with doing his best, but when his shops are so full that he cannot keep up to time he receives the obloquy of all. It must be admitted that the manufacturers of electrical apparatus have met with most generous consideration at the hands of both consulting engineers and municipalities. Probably this indulgence arises to some extent from the difficulty in enforcing penalties, but whatever there may be in this, there has been no disposition to harass manufacturers in spite of their delinquencies.

If orders remain unexecuted a few weeks beyond the specified period it may be highly inconvenient, but when weeks pass into months and occasionally into years before electrical plant is delivered, the matter goes beyond the bounds of reason. Yet it is well known that makers of electrical machinery, in one or two cases, have been over 18 months behindhand with their machines. These are probably the worst instances, but they show in the clearest possible manner either that some shops are overrating their capacity, or that there is some strikingly bad management. In the comparatively early days of the electrical industry, when manufacturing concerns rarely or never paid dividends, it was urged, possibly with some reason, that extravagant prices of patents, with the resultant over-capitalisation, were responsible for the inability to make profits. But nowadays all that is changed; the electrical industry is practically free from patents that touch the main features of electrical supply, and the chief effects of over-capitalisation have been swept away. How is it, then, with the prospect of fair profits, with the accumulated experience of years, and the employment of the most highly skilled labour, that so many English manufacturers are unable to keep their promises? To some extent the matter is capable of explanation. Up to a certain point the demand for electrical machinery was a gradually increasing one, and manufacturers were able to complete contracts somewhere near the specified time. So far as we are aware, however, there appeared to be little disposition on the part of the managers of workshops to look a little ahead, and make some provision for the boom in electrical plant that was bound to come; so long as the work in hand was completed the morrow might take care of itself. We are not for a moment suggesting that every manufacturer in the country was imbued with this policy of *laissez faire*, but we do not exaggerate when we say that the great majority have acted on this principle. What is the result: the boom in electrical enterprise has come and filled the English shops to overflowing, and the orders have followed so rapidly on

one another that the energy of a portion of the staff has been devoted to carrying out extensions of the workshops. Orders for plant have been taken with a sort of blind faith that everything will come right in the end, and probably it will, but in the meantime there is a reckoning to be paid. It is never pleasant to turn work away from one's doors, but assuming one has a clear knowledge of the possible output of a shop, it seems the height of folly to endeavour to double it. A harsh term would be applied to a person who sought to put more than a pint into a pint pot, yet that is precisely what the home manufacturer has been attempting. There may have been an idea that when the large towns had put down electrical machinery there would be very little more required; but the systems at present in existence have done little more than merely demonstrate the commercial possibilities of electric lighting and power supply. Before electricity is supplied to the average householder enormous plants will need to be erected.

Just when electric lighting had become established on a sound commercial basis, municipalities and tramway authorities became convinced of the economy of electricity when applied to tramways. But the demand for tramway plant and materials that followed has found our English works totally unprepared to meet it. Our American friends very readily perceived our state of unpreparedness, and they have quickly filled the breach. The consequence is that some of the very best orders for electrical machinery are to-day crossing the Atlantic. We are quite aware that the strength of the Americans in this country may be exaggerated. If the newspaper reports are to be relied on, the chairman of the Midland Railway Company has declared that the engines which have been recently supplied by the Americans were not nearly so good as those constructed at home. There are authorities in this country who maintain that many of the engines supplied from America for tramway work are inferior to those of English manufacture; but whatever truth there may be in that opinion, it is obvious that if American engines can be relied upon to perform fairly satisfactorily, they will, by reason of quick delivery, continue to be used to a considerable extent.

Although we have pointed out the delay that has arisen in the delivery of a good deal of electrical plant, we readily enough admit that the majority of firms will not at the present moment accept orders for machinery under a somewhat protracted period. That must necessarily divert orders either to America or to the Continent, but regrettable though that may be from a merely insular point of view, it is, from the standpoint of the electrical industry, infinitely to be preferred to keeping customers waiting for long periods.

Here and there workshops spring up, and for a time, at least, their chief advertisement is "early delivery," and apparently on the strength of that alone they secure a large number of orders, but their shops are soon overstocked with work, and very speedily they join the ranks of the great majority who are too busy to promise delivery under six or nine months. The cry of too much work is an irritating one, and it is doubtful if the manufacturers are doing any good to themselves by constantly repeating it. It may give rise to the reflection among men that either English works are limited in their capacity, or they lack organisation. In some industries it is astonishing how the supply keeps pace with the demand; we take it that neither Whiteley's nor Lipton's would ever have succeeded if they had become too busy. A growing demand needs courage and a long head in order that it may be properly met.

It is almost unnecessary at the moment to enlarge upon the superior position of the American firms to English houses in their ability to deliver plant quickly. At different times we have endeavoured to analyse the causes that account for these marked differences between the American and English electrical industry, but whatever may be the true reasons, the effects are occasionally brought before us in the most forcible manner. The demand for electric motors must be already a very large one, but when electric driving becomes properly recognised, both in large and small factories, an enormous number of motors will be required. With the present limited use, however, English manufacturers cannot supply them under some months. Quite recently a well-known engineer endeavoured to obtain a considerable number of electric motors for a client, but it was impossible to secure them within a reasonable period in this country; yet within three weeks an American firm was able to deliver the complete set of 40 of varying horse-powers. English manufacturers would have designed and made them specially, the American firm took them from stock.

American Workshops in England.

It will be a matter of great interest to watch the developments of American enterprise in establishing workshops in England. If the Westinghouse Company at their new works are likely to employ 5,000 men as anticipated, the question arises, Where are these men to come from? If skilled men are wanted they will have to be drawn by superior inducements from other employment. These being obtained, and working, we may suppose, equal hours with men in other shops—they will hardly be allowed to work shorter hours by an American management, accustomed to the long hours of America—will there be any trouble with the trades unions when the American method of multiple tools is, as it will be, insisted upon? Will the now discredited Amalgamated Society of Engineers make a fight over the employment of floor-labourers to attend to automatic machine tools? We feel much inclined to welcome the American company in establishing its works in England. English wages are not much less than American, in many cases they are higher. Per unit of output under the paralysing influences which have crippled English practice, the wages cost is distinctly higher all round. Assuming that the American company can effect no good with its workers, it will be a very simple matter to charter a large steamer and land 1,000 men at once from New York at the works on the Ship Canal at Manchester. There are plenty of workmen in America who would, if required, make the change. They might not at first like the change, for an American is intensely conservative in his habits of life, and does not mind sleeping in a windowless cell if he can only get green corn to eat. But he would in time find that climatically and otherwise he was better off here than at home. Bar the lack of transit facilities, England is a pleasanter country to live in than America. We may take it that a sufficient force of American workmen could be permanently maintained at the new works. In receipt of good wages and well housed no outcry could be raised against them, and they would be safe from outrage in a way they would not be in America. We should then have the spectacle of the new works underselling most competitors, simply because of its cheap output. This could scarcely go on; the closing of works unable to compete would follow. It might be necessary to do this before the trades unions recognised the folly of opposing new methods any longer. The new works would, however, be a centre of influence, from which surely better ideas would radiate. Secure against the tyranny of a works' stores, too common in America, by the protection of our Truck Act, and generally under the protection of English law, we do not see that the American works could become an evil. The methods of the Carnegie Company would be impossible, and Pinkerton men to shoot at sight could not be employed. On the whole, therefore, a healthy competitive influence may be anticipated. It must strike the more thoughtful of trades unionists that one consequence of their efforts to defeat modern methods of production should have been the planting of a large works right in our midst to carry out such methods. While we have assumed the possibility of a struggle, we scarcely think this will arise. Those behind the scenes know that many English workshops have been enabled to make great changes since the strike of 1897, and probably the new works will simply serve as a stimulus all round, and hasten the adoption of better methods. There is room for more manufacturing in England; at present it is impossible to obtain anything in decent time. Steam engines, cars, motors, boilers and all classes of engineering work can only be obtained in reasonably short period from America. It is quite time this was changed.

A "FIN-DE-SIECLE" MACHINE SHOP.

By FRED. BATHURST, A.M.I.E.E.

(*Concluded from page* 279.)

Fig. 10 shows a most compact and important machine, being a simple combination which avoids a separate pumping

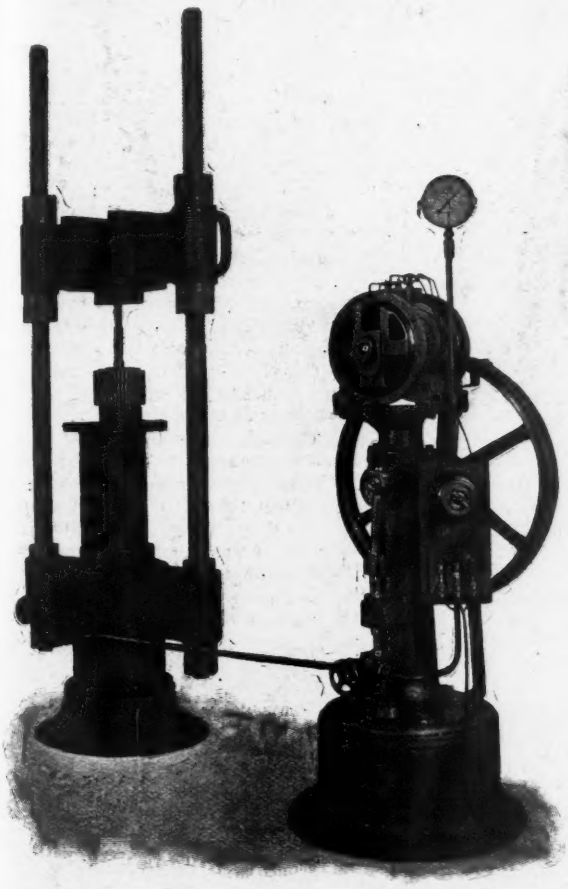


Fig. 10.

engine and its unnecessary gearing. It represents a convenient design of vertical type hydraulic press for compressing small armature bodies, commutators, &c.

A 1½ H.P. motor is single geared to a small single-acting pump, the pipe from which connects to the plunger chamber of the press. In this particular press a total pressure of 15 to 20 tons can be obtained, complete control being maintained by the indication given on the recording gauge seen at the side of the pump, and which indicates up to 2,000 lbs. per square inch. With the specially constructed cross head fitted to this press, it will be seen that the laminated armature discs for a drum-wound armature body can be quickly pressed together, or the machine is equally suited for pressing a shaft into the carrying spider for a gramme ring body.

Fig. 11 shows an excellently compact and well designed field magnet spool winding machine. This special machine is driven directly by a 1 H.P. motor arranged on a sliding base and controlled by a rack and pinion. The winding shaft is driven through a train of gears from a flat circular friction plate. Any speed of winding can be obtained by moving the motor in or out along its base plate, so that the pulley on its armature shaft drives against the outer or inner periphery of the friction plate, according to the relative position of the motor. The machine is fitted with a wire-holding or tension gear, and the usual train-wheel counter for registering the number of turns of wire wound on to the spool is provided. Its approximate cost is about £70.

Incidentally this combination shows the simplicity of the application of a separate motor to a machine requiring comparatively small power, and which may have to be run at varying speeds and yet be started and stopped at pleasure. The field magnet winding machines usually employed in dynamo shops are designed on the lathe principle, and have the loose pulley running continuously, but inasmuch as considerable time must be spent in adjusting the insulation of each spool, and spools when filled with wire have to be changed and replaced by others, it has been found to effect a considerable daily saving in the main engine driving power to adopt winding machines of this type.

Fig. 12 is interesting as an illustration, in that it shows the size of the tools that will have to be provided in shops laid out for the manufacture of the multipolar generators, which must ultimately take the place of the comparatively small machines at present employed in English station practice. This represents one of the large lathes specially constructed in the Kolben shops for the purpose of tackling pieces of work up to 30 feet in diameter. The work shown in the illustration is a 64-pole revolving type magnet wheel, weighing over 55,000 lbs. The pole faces are being trued off, so that the magnet will set accurately within its correspondingly immense and stationary armature ring. The main construction required in this lathe is its solid bed-plate, with the necessary well-hole and adjustable bearings, capable of accommodating removable plummer blocks for carrying the bearings of any sized shaft. The tool head is comparatively only an insignificant part. The work is revolved on its own shaft by being belt-driven from a 8 H.P. motor, which in order not to further encroach upon the floor space occupied by the bed-plate, is bolted to the side of the shop wall well up above the machine. The turner has complete control of the operation of this lathe by means of the motor switch and loose belt levers arranged near at hand.

Fig. 13 shows a small portion of the armature-winding department, and is interesting in that it shows side by side the "ancient and modern" in armature construction. On the left, supported on their wooden rests (easily recognisable

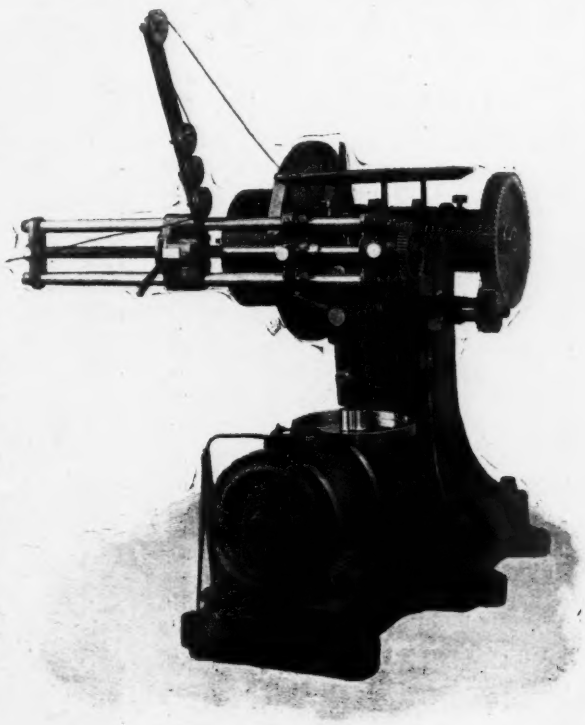


Fig 11.

from their compact and solid form and comparatively small diameter) can be seen "gramme" ring, and "drum" wound armature for machines of varying size, from 25 KW. to 200 KW. On the right can be seen the two huge semi-circular shaped castings, which are ultimately to form the

stationary armature of a 1,000-H.P. three-phase generator. This side-by-side comparison sufficiently accentuates the kind of change that may have to be encountered when a dynamo shop proceeds from the manufacture of small to that

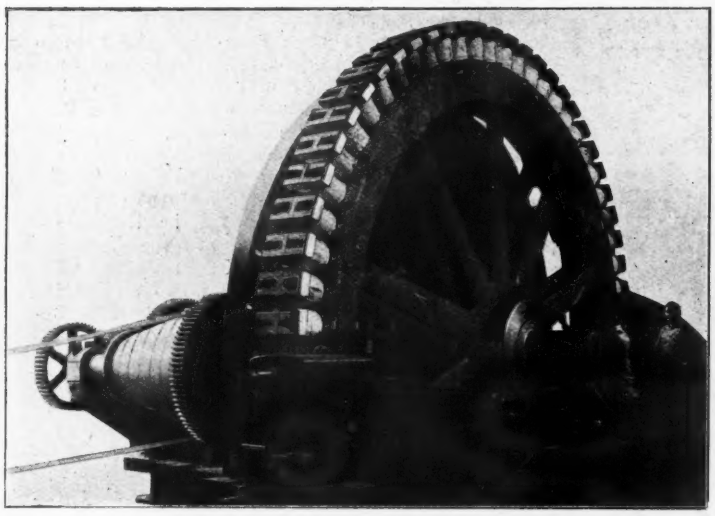


Fig. 12.

of large generators. In the distance will be seen the assemblage of two large armature body rings, one arranged inside the other; and further in the distance, on the left, the erection of the wrought-iron frame of a large switchboard.

Overhead may be seen the bottom of the controlling cage and the hanging chain of the travelling crane that runs over this section of the shop. Every modern shop designed to handle large castings will, of course, be equipped with electric travelling cranes which can run the whole length of the shop and work over a system of shop tramway rails, so that the castings can easily be passed on from one shop to another. Although the Kolben Factory consists of only two large main buildings, one of which is divided centrally, accommodation is found for no fewer than *six* large travelling cranes, two each of 5, 12, and 15 tons, having spans of 30 and 40 feet respectively.

Fig. 14, although not actually photographed in the Kolben shops, shows a 50-ton three-phase motor crane, made by this firm for a neighbouring locomotive works, with double travelling trolleys, so as to be capable of handling small locomotives *en bloc*. In this case the longitudinal motion is given by a 12-H.P. motor, the travel of the trolley by 3-H.P. motors, and the lifting by 20-H.P. three-phase motors.

The application of three-phase current to crane work might, at first sight, be criticised on account of extra complication in respect to wiring connections, but these practical examples show convincingly that all difficulty is easily avoided. The three main trolley wires required along the shop are easily provided for, and although 11 contact strips or wires must be provided on the crane girder itself, the greater simplicity and compactness of the regulating boxes more than counterbalances any objections which might be raised as to complicated connections.

In addition to the main shop cranes, the side bays of the shop, which cannot be covered by the travelling cranes, and in which the smaller kinds of tools are placed, are provided with separate hand-power cranes, either travelling or stationary, as demanded by the nature of the work to be handled. The upper parts of some of the side bays are made to provide extra working galleries in which the small detail parts are assembled or finished, and switch or other small work made. One finds in these cases that the labour of handling material is reduced to a minimum by the provision of electric elevators to convey material from the shop floor to the upper level.

Fig. 15 shows the complete elevator equipment. The machines are designed to raise an ordinary flat platform cage, loaded up to 1,100 lbs., at a speed of 60 feet per minute.

The winding drum is driven by a 3-H.P. three-phase motor, which runs at 1,440 revolutions. The gearing arrangement adopted was originated by the Kolben Works. A specially made phosphor bronze screw is arranged on the motor shaft, so that it drives on to a hardened and polished steel worm wheel on the drum shaft; by this means a direct reduction of 1 to 40 is obtained without other gear apparatus, and a very compact and economical combination effected. This elevator runs without any attention, being quite automatic in its action; the movement of the starting rope raises the brake on the motor shaft, and operates the three-contact armature resistance controller at the same time, so that the cage starts slowly and smoothly.

The complete motor and winding drum equipment weighs about 600 lbs., and costs approximately £120. The overall dimensions are:—Height, 2 feet 2 inches; width, 2 feet 10 inches; length, 3 feet 2 inches.

The liberal use of cranes and portable power apparatus in this shop not only reacts favourably upon the time taken in finishing and assembling the complete machines by almost entirely superseding the "gangs of labourers" ordinarily required in busy shops to move the heavy castings from

Fig. 13.

place to place, but materially reduces the usual standing charges of shop production. In fact, throughout the whole of the shop every possible economy in time and labour seems to have been considered, for on passing from the machine shop to the foundry, not only is it found that

the pig iron and coke is served to the cupolas by elevators of the type shown in fig. 15, and the draught furnaces maintained by means of 20-H P. three-phase motors driving the air-blowers, but recognition has been taken of the fact that the foundry is usually behind time in keeping up with the production of the machine shop. When working upon such large castings, it is obvious that a comparatively small

Fig. 14.

number of patterns will occupy a large amount of floor space for moulding purposes, and inasmuch as these large moulds, even when formed, may take many hours and even days to properly *dry out*, delays may, under ordinary conditions, ensue. The output of the Kolben Factory has practically been doubled without any increase of floor area by laying around it a comprehensive system of piping, through which a current of air can be forced to any desired part. If a large mould has to be finished as quickly as possible a portable coke oven is placed about it, and a flexible pipe connection made from the air pressure system, so that a steady current of warm air can be passed into any part of the mould as required. In this way moulds of awkward shapes and sizes can be dried out far more evenly and rapidly than when left for the usual open air drying, and the floor space accommodation is utilised to its utmost capacity, the same spot often being used three or four times over in the time originally required, as when the moulder, leaving the drying to Dame Nature, could take "his own good time" and regulate the floor output to suit his own particular view or fancy.

As the main object of this article has been to describe a series of important labour-saving processes and tools, the matter descriptive of the factory itself has so far been kept in the background, that the casual reader interested in shop practice may probably have formed the opinion that the tools illustrated could only be found employed in one of the oldest and largest machine shops. In truth, however, it is scarcely four years since the acre of ground upon which these shops stand was first broken, but so rapidly has demand followed upon ability to turn out the highest class of work, that to-day we find 300 skilled Bohemians busily employed, and working in day and night shifts, with as much method and order as if the whole establishment were practically one huge machine. The transformers made vary in size from 100 watts (used for voltmeters and switchboards) to 500 KW., and the motors and generators from ½ H.P. to 2,000 H.P., the bulk of the work being the larger sized units required for important town lighting and power transmission plants; hoists, cranes, railway motors, switchboard equipments, all come as extra grist to this electrical mill. The turnout increasing proportionately with the growth of the works may well be envied, the present year's output alone in transformers, generators, and dynamos of all sizes being estimated in the aggregate at 50,000 KW. total capacity.

The power transmission plant of the shop is also unique in its way, as it illustrates how much can be effected from small resources, provided the guiding hand has the requisite knowledge and experience.

Whereas it would be thought that a factory employing so many machines must require a main steam plant of considerable horse-power, one is surprised to find that the whole factory is driven from a 120-H.P. engine. Two Lancashire boilers of 120 H.P. and 60 H.P. each respectively (180 H.P. total) supply steam at 120 lbs. pressure, which is then passed through a superheater (utilising the heat of the boiler flues) and raised from 170° C. to 270° C., at which temperature it is passed into the parallel cylinders of the compound engine. By such superheating the condensation losses are kept very low, and a very high steam efficiency obtained. The exhaust steam warms the shop in winter, or gives a hot water supply for the boilers.

Both boilers and engines are housed side by side in a building 40 feet × 40 feet, the actual size of the engine room being only 40 feet × 16 feet, which explains the difficulty of obtaining a better general view of its arrangement, than that shown in fig. 16.

The engine is belted directly to a 120 H P. three-phase current generator of 91 per cent. efficiency (50 cycles), 220 volts, and provided with its own fixed exciter. Some 50 electric motors, having capacity from ¼ to 20 H.P., are employed in the shops, the majority being operated at 200 volts. Owing to the comparatively small size of motors employed, and their consequent high speed and the difficulty of gearing them down, the shop shafting is run at 270 revolutions per minute instead of about 180 revolutions, the usual standard speed for ordinary machine shop practice. This higher speed is, of course, advantageous and quite possible under the conditions of lighter and shorter shafting runs.

The shop wiring is arranged with an earthed neutral, so as to prevent the possibility of the workmen receiving shocks, and to allow light to be supplied on the single phase from either of the three wires at 125 volts. The lighting can be taken

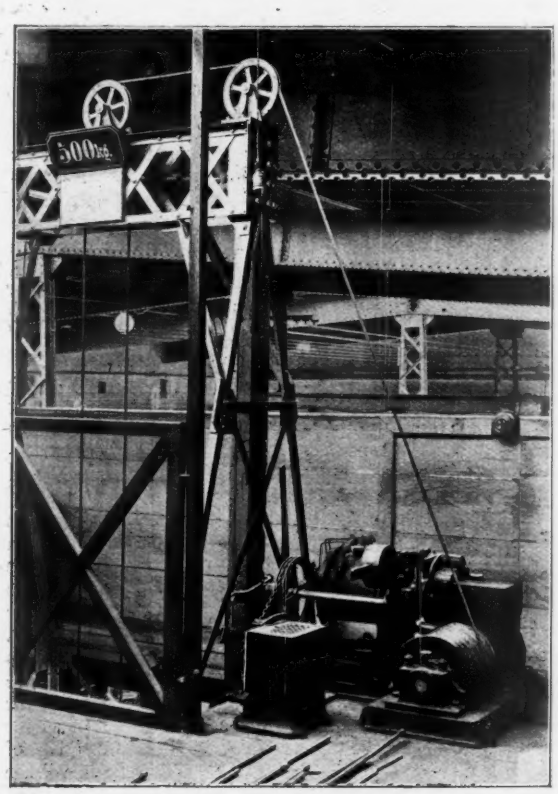


Fig. 15.

direct from the power wires throughout the shop, or, if desired, from a set of accumulator cells.

The accumulator is charged from the three-phase generator by the intervention of a rectifier. This rectifier of 6 KW. capacity, although only in an experimental form, affords a simple and economical method of changing a three-phase alternating into a continuous current. It consists simply of

series of contacts and collector rings, arranged on a shaft, which is driven by a ½-H.P. three-phase synchronous motor, running off the main generator. A three-phase stationary transformer is connected to the mains from the generator, and the sections of the coils connected to contact rings on the shaft. These contact rings are again connected to a suitable commutator, so that the three-phase current from the transformers is collected as continuous currrent. This 6-KW. rectifier occupies less than 15 cubic feet of space, and the loss in the transformation does not exceed 5 per cent. Excessive sparking and other troubles would, of course, follow in large

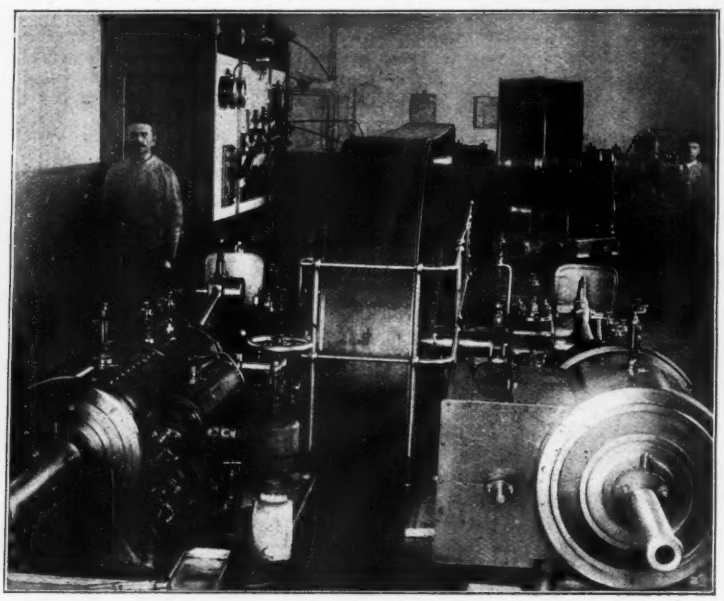


FIG. 16.

sizes, but Herr E. Kolben considers that it may eventually compete with the standard type of motor-transformer (three-phase to continuous current, with a loss of 8—15 per cent.) for capacities less than 30 KW. This suggestion has already been made by Mons. Le Blanc, of Paris, but does not seem to have been properly worked out. Mention is made of this apparatus, as it forms a very cheap and effective means of providing for an auxiliary accumulator for lighting and other purposes in connection with three-phase power plants.

A corner of the small engine room is allotted to the switchboard, which contains the ampere and voltmeter necessary for controlling the large generators, and switching out the feeder, supplying the current for power to the various shop circuits. The engine room arrangements are thus relatively as small and compact, as the number of tools and appliances provided for is large.

In connection with the utilisation of three-phase current in this factory, and looking to the fact that at last in England we hear of some important three-phase plants being projected, notably in Manchester for its lighting, and in South Staffordshire for power (this latter scheme proposing to instal two 1,000-KW. and four 2,000-KW. generators), it may be of interest to mention that the Kolben Works are already well advanced with the manufacture of the three-phase generators, and suitable motor transformers for the first instalment of a 15,000 H.P. three-phase plant for the city of Prague. The units in hand are five of 1,000 H P. and five of 2,000 H P. The high voltage distribution is to be effected at a pressure of 3,000 volts, and motor-transformers of 700 H.P. (or 450 KW. each) 240 revolutions, will re-deliver the electrical energy as continuous current at 600 volts. The main object of the scheme is to supply and extend the present electric street railway system in the town of Prague.

Comparisons are proverbially odious, but may not the consideration of this work undertaken by a *single* town as the outcome of its *immediate* necessities, lead us to ask how it is that a Continental town only fairly prominent in reputation and commerce, can give the lead to the whole of England in electrical supply undertakings of this nature?

Whatever schemes English electricians may have in contemplation for the *future*, the shortest visit to the Continent must convince them that we lag far behind in respect to street-railway and power-installation practice. From the fact that we have relatively so many large towns cooped up within our little island, in the matter of electric lighting, we may possibly find ground for debate; but here, again, a fair judgment must admit that we are also behind. The "slow and sure" and "wait till it comes along" policy that forms the keynote of English electrical development may, it is true, be best in the *long* run, but with Continental examples of electrical enterprise of all kinds before us, surely it is time that a little more "initiative" and "go" should be instilled into our "authorities and rulers," "professors," and "consulting engineers," lest in the competitive race we are now running, the idea that we are "already too old and fossilised" should become too deeply rooted, and even impossible to eradicate?

This article, however, must not become controversial, being intended merely to serve as an index for our dynamo manufacturers, as to the kind of shop practice that prevails in the "more progressive" Continental factories.

Conclusion.— Enough has, it is hoped, been said to show that throughout the practice of this factory such advantage has been taken of the most up-to-date ideas and methods of manufacturing as to justify the heading under which it has been introduced.

NOTES ON THE CAREER OF EMIL KOLBEN.

He passed through the ordinary Bohemian school course and entered a technical college to undergo an engineering training.

In his holidays, particularly the long summer vacations, he used to enter the neighbouring factories working as an ordinary hand. After serving in an engineering works near Prague for a short time, he decided, in 1886, to go to the U.S.A., and there entered the drawing office of the Edison Machine Works, in Schenectady, N.Y. He made rapid progress as a draughtsman designer, and became head man. He then set himself to work out the designs for the improved Edison bipolar machine with the shortened magnetic circuit, carrying out at the Edison Works what was proposed in England by Dr. John Hopkinson.

It was the thoroughness with which these old-type machines were re-designed that made it possible for the Edison bipolar machines to gain the reputation for reliability and solidity that they hold in America even to-day. From head designer Mr. E. Kolben became chief engineer, the Edison Works having grown during these few years from three workshops employing 300 men to over a dozen shops employing 1,500 workmen.

In 1891 Herr Kolben returned to Europe on a tour of inspection, and in order to make a report as to European practice. This revived in him the love of his native country, and he returned to the States as a married man, and with a predetermination to exchange the haste and bustle of American workshops for the more even and steady going progress of the European. Within a year he came back to take up the position of electrical engineer to the Oerlikon Works in Switzerland, just then vacated by Mr. C. E. L. Brown, now of the Brown-Boveri Works. At Oerlikon, Mr. E. Kolben again showed his aptitude for dynamo design by completing and putting into standard shape a complete range of three-phase motors, and working out to practical and commercial success several important three-phase and other power transmission plants, besides finding a sphere of activity in the introduction into Europe of his American street railway experience. In these early days of commercial power transmission work, Mr. Kolben's name was well known to the technical press for his contributions and notes on dynamo

machinery designing, and it is not too much to say that his paper "On the Best Periodicity," published in the *Electrotechnischen Zeitschrift*, in 1894, led to the general adoption of 50 cycles as the standard for three-phase apparatus. During his sojourn in Switzerland, Mr. Kolben had every opportunity for indulging his passion for recreation in the shape of mountaineering, and with Mr. E. Huber (proprietor of the Oerlikon Works) as an experienced companion, many difficult and so-thought inaccessible peaks in the neighbouring Alps were assailed and conquered. Whether, however, it was due to Mr. Kolben's love for the hills and heights of his own native country, or "the homing" of his Bohemian nature, in 1896 he decided to return to Prague, the town of his birth, and start there as an electrical manufacturer in his own name. He evidently chose the proper moment, for to-day we find Austrian manufacturing activities rapidly developing all along the line, and to judge from what has been accomplished in this factory within so few years, Mr. Kolben will have the satisfaction and reputation of having initiated an industry which will grow to be one of the not least important. Mr. Kolben is quite a young man—not yet out of his "thirties"—and has all the talent, energy, and experience necessary to develop his factory, so that, retaining his good health, he ought long to enjoy its fruits and reward.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 262.)

Fig. 72 shows the connections of "Ajax" lightning arrester for isolated plant, and fig. 73 shows the connections

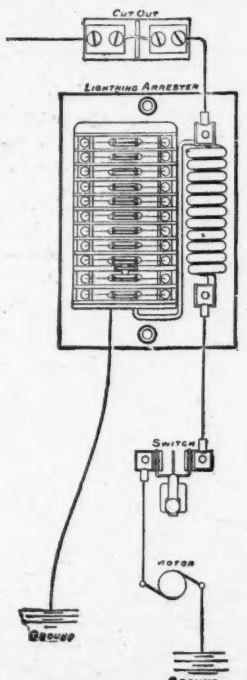


Fig. 72.—Connections of "Ajax" Lightning Arrester for Isolated Plant.

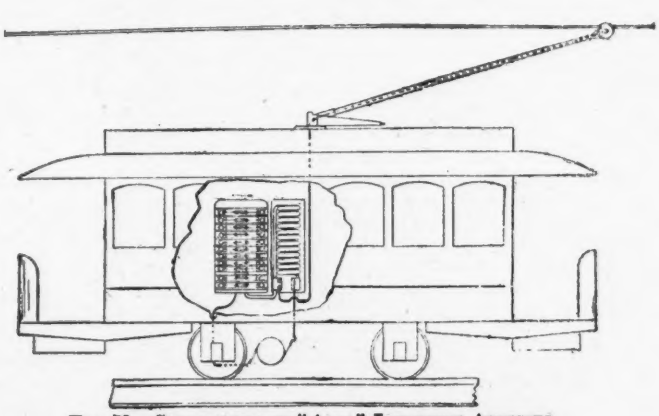


Fig. 73.—Connections of "Ajax" Lightning Arrester for Motor Car.

for a motor car. These should have appeared with last week's section of this article.

Trolleys.

In this country the type of car generally in use is the double-decked car, which is a legacy bequeathed from the stage coach through the omnibus and the horse tramcar to the electric tramcar. It is problematical whether this double-decked car is an unmixed benefit, but certain it is that to our eyes the single-decked car would look as strange as the double-decked variety does to American and Continental eyes. The form of swivelling trolley suited to and used for the single-decked variety is not suitable for cars having seats on the roof, and a special type has had to be evolved to meet the requirements of the latter. The trolley pole, instead of starting from the roof of the car, has had to be raised on a standard of sufficient height to prevent it and all moving parts from interfering with passengers. The chief desiderata in a trolley to ensure satisfactory working are the following:—

1. The head must be of a form having no angles or projections save the edges of sheave slot, in which the wire can catch and prevent the head from being hitched readily into position when the trolley has left the wire. It must be fixed so as to swivel freely at right angles to the wire, and it must be completely insulated from the trolley arm by a non-conducting sleeve.

2. The sheave must be of the "V" groove type fitted with non-heating (graphite) bushings, and mounted so that its axis is on a level with or below the end of the trolley arm, and in this way lessen the possibility of the sheave striking a span wire or bracket arm. It must be provided with ribs to hold the flanges in position after they are cut or worn through, and thus prevent the disabling of the car before the sheave can be replaced.

3. The trolley arm must be tapered throughout its length and reinforced at the butt, and it must be insulated at the carrying socket by insulating material of the nature of mica. It must be supported by outside springs fixed, so that the pull shall be as near as possible at right angles to the arm when the latter is inclined at its normal angle.

4. The springs must be arranged so as to exert a pull which shall maintain a pressure of 18 lbs. between the trolley sheave and the overhead conductor; this pressure remaining approximately constant while the arm moves through an angle of 30° on either side of its normal position; the tension of the springs being susceptible, however, of instant release or adjustment.

5. The socket for carrying the arm should be of malleable cast-iron, mounted on a pivot, and fitted with an adjustable stop to prevent the super-elevation of the trolley head, and should be pivoted on a malleable iron swivelling sleeve.

6. The sleeve carrying the arm socket should rotate on two sets of ball bearings round a steel tube socketed in the standard, a complete revolution being prevented by a stop.

7. The standard in which the steel tube is fixed should be an annealed steel casting, the base being arranged so as to be fixed on to the car roof by coach screws.

8. The cable should be run straight through from the head to the heavily insulated connection box in the standard where the motor leads end, and be so arranged as not to twist or chafe; its connection with the head should be easily accessible, and its insulation throughout should be as perfect as possible.

The accompanying figure, 74, shows a recent type of trolley (Dawson's patent) which complies with all the requirements above mentioned, and whose use renders it easy to work a road where the trolley wire is horizontally 8 feet to 10 feet or

more distant from the side of the car, as it instantly follows any variations in the line of the trolley wire from that of the track. It greatly facilitates construction, decreases the number of poles, and diminishes the necessity for span wires.

Trolley Pole Catcher and Reel.

The accompanying figure (No. 75) shows an indispensable adjunct to a satisfactory trolley. From one cause or another trolley sheaves are bound occasionally to leave the wire, and the long bamboo fishing rod with its hooked end is a fruitful source of delay and expense, besides being awkward and unsightly. This adjunct consists of an enclosed reel fixed to the dashboard, or any other convenient part of the car where it is readily accessible to motorman or conductor, on which a cord attached to the trolley head is wound. The movement of the reel is regulated by a coiled clock spring, which, as long as the trolley sheave is running on the wire, instantly takes up the slack rope or pays it out to meet the inequalities of the overhead conductors. Immediately the sheave leaves the wire and the pole jerks upwards under the influence of the springs, the jerk brings a device resembling a centrifugal governor

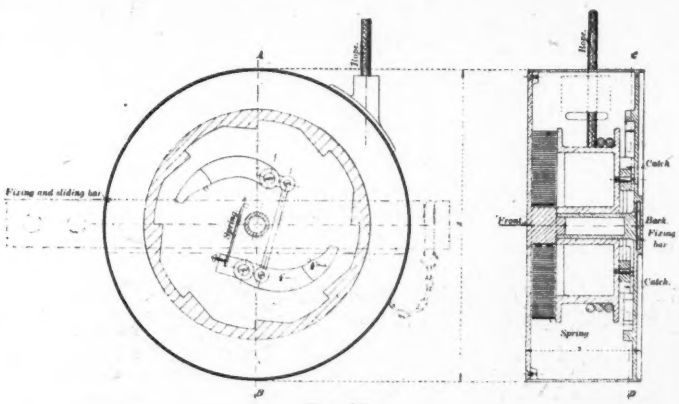


Fig. 75.

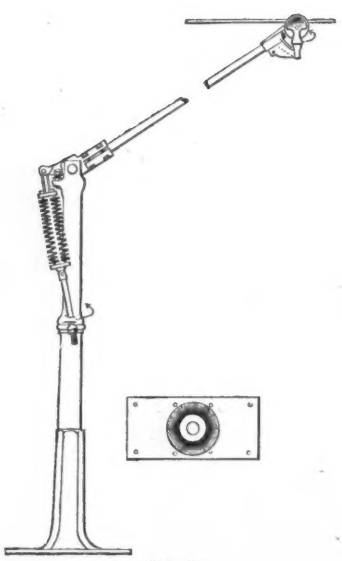
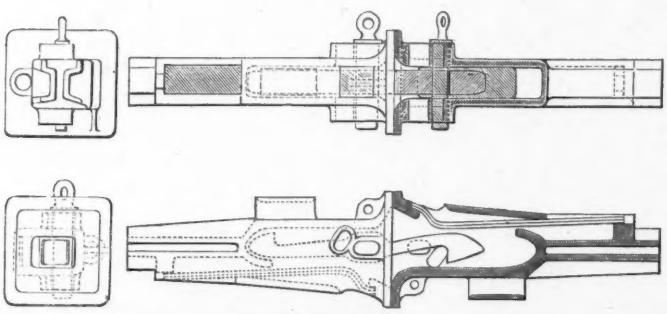


Fig. 74.



Figs. 76, 77, and 78.

into operation, which at once catches the rope and securely holds the pole until it is released by the conductor. The catching of the pole and the holding of it in position presents the double advantage of preventing wear and tear and injury to the wire, and of permitting the adjustment of the spring pull on the trolley pole to either a higher or a lower standard than the one which is imperative where no such adjunct is used. This device is also the invention of Messrs. R. W. Blackwell & Co.

Couplings.

Automatic couplings, or, as our American cousins prefer to style them, "couplers," have been very much in the air of late in connection with goods waggons in the United Kingdom. The authorities of the Board of Trade have at last realised that their adoption will diminish the rate of mortality among long-suffering railway servants in a way no other innovation could effect. Many excellent patents and devices have been known, and to a certain limited extent, used, for the purpose of automatically coupling up railway carriages and waggons in the United Kingdom for years past, but have mostly languished or practically died a natural death from lack of the support of railway companies and waggon owners, which nothing short of the unanimous insistance of their employés or of the Board of Trade could have brought about. Fortunately, in the case of electric traction, no such vested reluctance exists, and the adoption of automatic couplings is more or less assumed as a matter of course on this side of the Atlantic just as it is on the other side. What is required of an efficient automatic coupling is that it shall be—1st, perfectly automatic; 2nd, absolutely reliable; 3rd, impossible to get out of order; 4th, capable of coupling cars so solidly together so as to ensure perfectly smooth running, free from all jerking motion under all conditions of service; 5th, capable of coupling and uncoupling readily with the least possible longitudinal motion of the car; 6th, capable of use without alteration with any type of non-automatic coupling in general use; 7th, simple in construction and lasting in details. The first requirement entails the introduction of springs in the heads of the couplers, and requirement No. 5 demands that they shall be so set that they will engage or disengage with the coupling hook in a distance of, say, $\frac{1}{64}$th of an inch, or in practice $\frac{1}{16}$th of an inch. The second requirement demands that the spring shall be so carefully shielded, from casual injury and wear and tear, within the solid head of the coupling that they shall last as long as any other portion of the coupling and continue reliable to the very end. Solid coupling and absence of jerky motion is ensured by the same conditions as No. 5, but their subsistence under all conditions of service requires certain structural peculiarities which merit careful consideration, and are well exemplified in the Van Dorn coupling under consideration. In going round curves both coupling and draw bar must be free to swivel so as to assume a true tangential position to the curve at the point midway between the car ends. With the single or four-wheel type of truck this is effected by fastening the drawbar by a universal joint to a draw plate which is bolted to the centre of the underframe of the car body. This universal joint is free to act in two planes only, so as to avoid all twisting in the coupling head. The ball piece is attached to the drawbar by fishplates which allow of wear in the ball, to the extent of $\frac{3}{4}$ths of an inch, being taken up, and the joint is cushioned with India-rubber washers. This practically ensures at least a life of five years in the joint without repairs or sensible elongation. In double bogie and maximum traction cars the drawbars extend to the king pins and swivel around these. The draw bar

consists of either a plain flat steel bar or of a "T" section, the latter being specially suitable for very heavy traffic. In the case of the flat bars, which are often of 1 inch × 8 inches section, the coiled springs, which cushion the pull, are fitted in the car end of the coupling head, while in the T-section bars (80 lbs. to the yard) they are placed in a special holder close to the king pin. The heads are supported by steel carriers beneath the car balcony ends, as shown in the accompanying figures. The coupling hook forms a common pin and link coupling at one end, which meets requisite No. 6, as it is capable of use with any non-automatic coupler. The heads are furnished with two pins either of which can be used and their life consequently doubled. Fig. 76 shows the coupling heads ready for coupling, and fig. 77 the two heads united. The coupling can be placed in either of the drawbar heads, when the hook enters the opposite one with the pin in the sloping hole, the springs in the inner side of the head are sprung out sufficiently to allow the hook to pass round the pin and lock. To uncouple, the pin in the sloping pin hole is pulled up, and coupling and uncoupling is readily effected if required in $\frac{1}{64}$th of an inch.

(To be continued.)

ELECTRIC HEATING INSTALLATION.

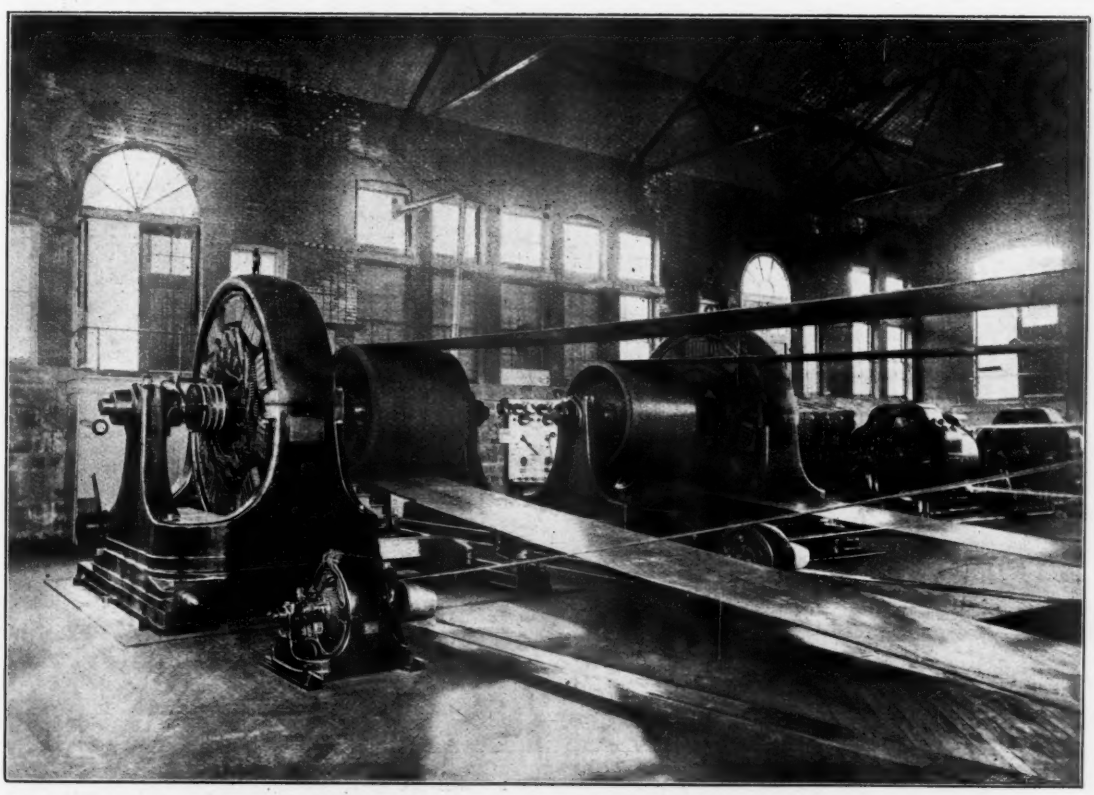
By O. E. DUNLAP.

In their new Hospice of Mount Carmel, at Niagara Falls, the Fathers of the Order of Mount Carmel in America have taken advance steps in the matter of electric heating, and the installation they have perfected is not equalled in the world.

Away back in the early twenties the first little chapel or shrine was built, and in this place the Catholics from all countries have worshipped. In the grandeur of the great cataract, the late Archbishop Lynch, of Toronto, early saw an inspiration for devotion, and petitioned Pope Pius IX. to grant all the favours and privileges of the European sanctuaries to the little shrine at the Falls, with permission to transfer the privilege to a new shrine when completed. When the structure is completed as planned it will form one of the greatest buildings for architectural beauty and completeness of detail in America. At present the structure consists of the main building and one wing, and in the course of time the hospice and shrine will be combined. Then the shrine will occupy the centre between the two wings, the northernmost one of which will be the home for guests or pilgrims, and the southern one will be used as a monastery. The institution is on the same original plan as the famous hospice of Mount Carmel on the Mount of that name in Palestine. However, the hospice at Niagara Falls is modern in every particular, and founded on the latter day principles of the order of Carmelite Fathers.

Standing on the bluff back of the Falls, the hospice occupies a site unequalled in the world for beauty of surroundings. It is far enough back from the Falls so that the spray cloud does not reach and fall upon it, and from the upper windows the magnificent panorama of the Falls and gorge is spread before the eye. The present wing forms an L, the length of the sides of it at the foundation being 200 and 250 feet, while the height from the ground to the top of the towers is 85 feet. The buildings are of stone, the front being beautified with an arcade having massive granite columns.

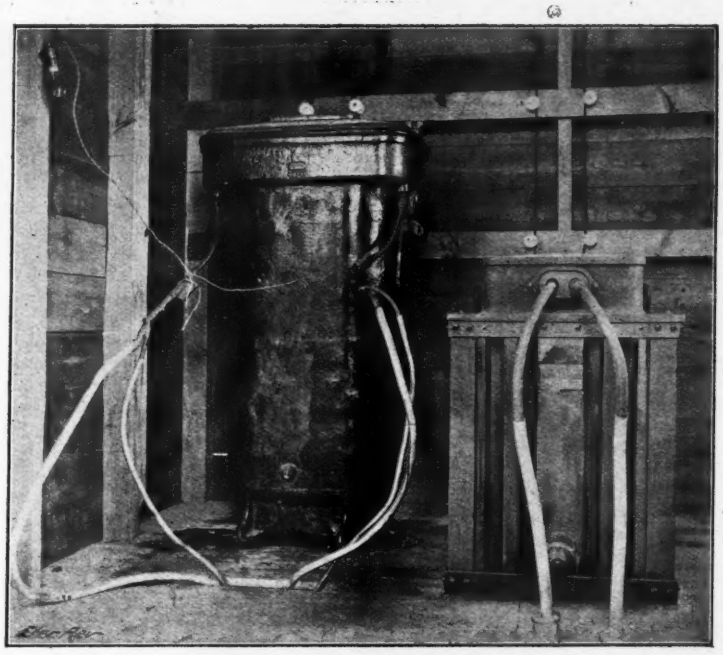
The hospice is located about two miles from the power house of the Niagara Falls Park and River Railway, in which station the Canadian Niagara Power Company have two generators installed for a temporary power service. It is from the Canadian Niagara Power Company that the Carmelite Fathers get the electric power used in the building. As it stands to-day the building contains 200 16-C.P. incandescent lights. For lighting the building, for cooking, and for heating water 25 H.P. is being used, while 75 H.P. is, in time of need of such service, used for heating the lower floor of the building, which comprises 11 bedrooms, a dining room, reception room, office,



Power Station of the Niagara Falls Park and River Railway.
Where the Temporary Plant of the Canadian River Power Company is located. Showing Generators.

and the corridor. The corridor is 120 feet long, 10 feet wide, and the ceiling has a height of 15 feet. In this corridor are located nine 4-H.P. heaters. The bedrooms are 10 by 12 by 15, and in each is located one 4-H.P. heater with changeable heat switch of two heats.

The hospice transformer house is located about 150 feet west of the main building. It is a small wooden structure,

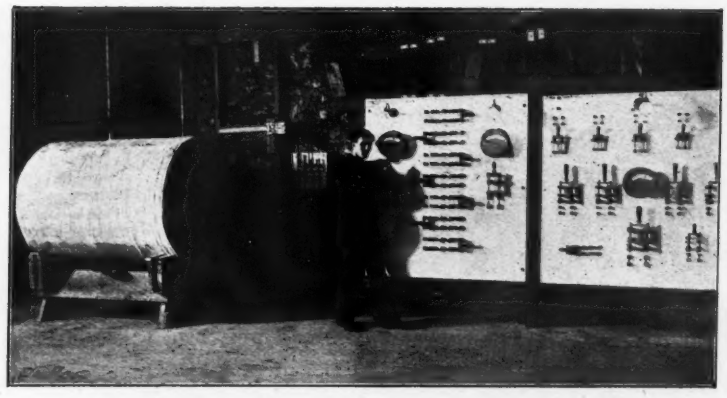


Transformers.

and over it tower two poles with a double cross-arm from which the wires descend to the station. In this transformer house are located two 30-KW. Westinghouse and one 25-KW. General Electric transformer, primary 2,200 volts, and three-phase secondary 110 volts. From this station the current is transmitted to the switchboard in the main building through an underground cable.

a capacity of 400 gallons, and is to be seen to the left of the switchboard in the illustration. The other has a capacity of 150 gallons, and is located in the south corner of the switchboard room. The 400-gallon boiler is used to heat water for the laundry and bath room. It takes a current of 120 amperes, being divided into three heats. The 150-gallon boiler takes 125 amperes, and is also arranged for three heats. This boiler is used for quick boiling. Both boilers are covered with 2½-inch asbestos covering. An important feature is that all water is boiled when the current is not being used for any other purpose. In the 400-gallon boiler water is raised from 60° to 212° in six hours with full heat.

In the butler's pantry there are three 5-gallon urns



Switchboards and 400-Gallon Tank (water electrically heated).

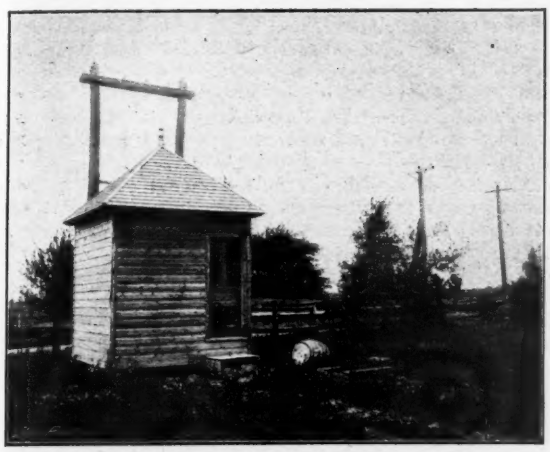
The switchboards of this novel installation will be seen in the illustration. The panels are of white marble. The switchboard with double-throw switches controls two phases of the current, while the third phase is controlled by the other switchboard adjoining, and is used for cooking, lights, &c. Both switchboards are so arranged that either transformer can be used independently of the other for either purpose.

The hospice is also equipped with two hot-water boilers, both of which are operated by electricity. One of these has

and a chafing dish, all electrically operated. In the kitchen are found an electric combination range and three ovens. The range has a heating surface of 6 square feet, and each square foot of surface has a switch and can be controlled to either full or half-heat. The largest oven takes 50 amperes, and is so arranged as to cook four 25-lb. roasts at one time. The two small ovens each have three compartments, and each consumes 23 amperes at 10 volts. On the door of the large oven there is a thermometer, which shows the heat and states the temperature through the

different time of roasting and baking. As the point of baking or roasting is indicated, the cook can make no mistake. As the heat is uniform, the cook is enabled to have her output of food uniformly cooked, and there is no burning or over-roasting. In the small ovens, bread can be baked in 18 minutes, and one day in June a dinner for 250 people was successfully cooked in this electric kitchen. One most gratifying feature to the cook in charge of this kitchen is the manner in which she can regulate the heat. Then all the pots and other dishes are always nice and clean, there being no deposit of dirt on them as from gas or other fuel.

While it is not possible at this time to make a very extended comparison of the cost of the work done by this installation, with what the same results would cost by other means than electricity, some general statements can be made that are of interest. If the cooking and heating were done the old way, they would require the services of



Transformer House.

two men, whereas they now require the services of a woman only. The man who has charge of the electric plant also looks after the office, and, in fact, has general supervision of the building. No extra help is required to look after the installation, the man in charge simply looking the plant over occasionally.

The annual cost of the electric energy used in the building for cooking, lighting, and heating water, is $625, which is 25 H.P. at $25 per H.P. If these things were done with coal as fuel, the cost would be $1,140. In the power the monastery or hospice uses for heating, it is at present exceptionally fortunate. Such supply of power is required for only about six months in the year, and as the power station from which the supply of current is received has not such a great demand on it for its energy during these months, as in summer, owing to fewer cars being run, there is a surplus of power which the hospice enjoys at a rate about one-fifth that paid for the 25 H P. above referred to. This is indeed an exceptional consideration, but under such circumstances it is evident that they can afford to use electricity for heating purposes.

In previous winters the power station of the Niagara Falls Park and River Railway has been greatly annoyed by the gathering of anchor ice at the inlet, and this has resulted in the installation being shut down for days at a time. Of course, when the Canadian Niagara Falls Power Company get their proposed new station running, it is not at all likely that the ice will bother its operation to this extent, but then the ice on the Canadian side above the Horseshoe Fall is likely to be far more troublesome than it is to the Niagara Falls Power Company on the New York side, the water conditions being quite different. However, the experience of the past winter, which was most severe on all the Niagara power companies, has developed the conviction that under such conditions, where ice is likely to bother a plant used for electric heating, it would be wisdom to instal a combination electric and fuel system of heating water, so that when the ice bothers the operation of the electric apparatus fire could be put under the boiler to heat the water which would otherwise have been heated by electricity. In other words, instead of carrying the electric current through the building for heating purposes direct, it would be better to apply the current to the boiler, and have a hot water system of heating. Then, should there be an interruption of the electric service, the fuel combination could be effectively used. It would seem that in a case like the hospice, this would be an ideal system, for all the results obtained at Niagara have been thoroughly satisfactory.

The electric plant in the Carmelite hospice was installed by Mr. A. Harth, an electrical engineer who has given much attention and study to the question of heating and cooking by electricity. The apparatus was made by the Hathaway Electric Heating and Engineering Company, of New York.

CORRESPONDENCE.

Converting Old Electric Lamps into New.

I have read your article on the subject of "Renewable Incandescent Lamps," also the various remarks of your several correspondents, with pleasure. Now, as I claim to be the *first and original Inventor* of the above process, perhaps a few remarks from me may be interesting and of use to the electrical trades, also tend to put the subject matter on a solid base. For in the face of facts, why £100,000 should be asked for a presumed patent is more than I can comprehend. For in the face of my completed patent No. 11,802, which is dated as far back as June 30th, 1888, everything of importance relating to the subject of converting "old lamps into new" is covered in my patent, and more, too, than is claimed by Messrs. Howard and Mayer; therefore, in the face of these facts, I do not consider their patent is worth a "£10 note," much more the £100,000 asked for it. Any electrical firm desirous of going into the renewable lamp industry, can do so without the least fear of infringing anybody's patents; moreover, the elongated and expansive type of bulb used in the proposed new system, upon which so much importance is laid, was also patented by me in a former patent taken out by me as far back as December, 1883, and, singular to say, my 1883 patent, covering the elongated and expansive bulb, was procured by Messrs. Hazeltine & Lake, the very agents who have taken out the patent for Messrs. Howard & Mayer, and if my memory serves me right, the latter gentleman, at the time I was in Germany teaching my system of manufacture, acted as consulting engineer to the very firm who purchased the German interests in my renewable lamp patents, but probably the German-Edison Company, the Seel Company, or Mr. Carl Rhoeder, of Vienna, all of whom know of its existence, would be able to confirm this point, as they all were conversant with my work, the two latter firms having founded the lamp industry in Germany and Austria partly under my patents of 1883, and any expert sufficiently interested in the subject of lamp manufacture has only to compare the drawings and descriptive matter of my 1883 and 1888 patents to decide the questions under discussion and prove who is the original inventor of the system. I may here say in my patent of 1888, that the invention clearly states that the chief object was to re-use and make up soiled or damaged incandescent lamps, repair same, and to convert old lamp materials into new lamps, which I proposed to do by utilising the waste materials previously used in lamp manufacture, a description of which my patent agents said would cover everything appertaining to the converting of old lamps into new and a direct bar to future inventions of this class. Probably the best and most profitable part of my invention is explained in the following descriptions, viz.:—

(*a*). The methods of standardizing the filament.

(*b*). The manner of utilizing the old filaments to manufacture new lamps of lower voltage and candle-power.

(*c*). The improved method adopted in making a good mechanical joint between the filament and leading-in wires.

(*d*). The methods adopted for carrying the multiple connectors through the bulb for high candle-power lamps of, say, 100 to 1,000 C.P. A very important feature which is now generally adopted by all lamp makers.

(*e*). The methods adopted for reducing the vacuum of the lamps prior to remaking same up into new lamps.

(*f*). The methods of making semi-metallic filaments which I still maintain are the best (when you know how to make them), for very low volt lamps when used for battery electric lighting, and especially for night lights or photographic purposes where a great light is only required for short durations, and the watts used to produce the light of no moment as to cost of energy consumed, for which this class of lamp, which can be greatly overrun, is specially applicable for the purpose named.

I may also say that I was the first inventor who made multiple filament lamps, and monopoly of which could have been easily secured by this patent had the claim been upheld against infringers of my rights. My inventions were also patented in France and Belgium, also patents applied for in Germany and America, all of which several rights were sold, and certain parts of the said invention have been ever since profitably used by the purchasers of the said patents, who have sold millions of lamps made under my patents, although sold under other names. I have no doubt your readers will say, when they read these facts, Why on earth did not Shippey Bros., Limited, sell this patent, or work the Shippey process in England? Why was it not sold for £50,000 or £100,000 when it was apparently the only lamp patent in existence of its kind under which lamps could be made and repaired without infringing Edison & Swan rights? That is just the point which requires explanation, and which has puzzled everybody until counsel's opinion was obtained, and, in fact, the patents were privately sold for £20,000 to a company of promoters, and a prospectus was actually printed re-selling my patents to the proposed company for £100,000 for payment of patent rights, and also providing £40,000 for building the works and plant, and providing capital for working the inventions. But it was not to be; fate willed it otherwise. A splendid and profitable business could have been established, certainly with a far greater success in the year of 1888 than now, for the simple reason that in 1888 electric lamps were selling by the Edison and Swan Company, and other makers, at from 3s. to 25s. each, according to type of lamp and candle-power. Consequently, at such splendid prices it can easily be understood that it was then well worth while repairing old lamps and re-using the materials for making up new lamps; but to-day it is another matter, and a horse of different colour, considering the low market price of incandescent lamps to-day; consequently the repairing of same is not now worth the candle. As an instance, my company holds in stock to-day, as is well known, some 20,000 to 25,000 lamps of different types and voltages, 50 volts up to 110 volts, as made in Germany, Holland, and America, many of which have been made by the manufacturers under my own original patents, under *nom de plume* titles, in the very works originally founded by us and our associates, and these special lamps, I may say, we are selling at the following market prices:—German make, 5s. 6d. per dozen; Dutch and Belgium makes, 6s. 6d.; and selected Americans at 7s. 6d. and 8s. per dozen for gross lots, and, moreover, from which price we allow regular consumers of our lamps 1s. per dozen for all cap and lamp ends returned to us intact with platinum supports, for which parts and materials there is always a demand, as the holders and platinum can be used over again, and to-day there are three or four firms who make a regular business in collecting from users the old and used-up electric lamps, a business which was not thought of until the advent of my patent in 1888; and, in fact, the only parts of any value are the platinum and brass base caps, for since the Edison and Swan patents have all expired the old glass and filament is no longer of any value, it being much more expensive to re-make up the old lamps than by making a perfectly new lamp with improved filament and new glass bulb. Therefore the idea of asking the public to subscribe £150,000 to carry out the objects proposed by the Renewable Lamp Company seems absurd in the face of my expired patents, and I cannot but express my astonishment to find certain names who have associated themselves with the development of such a scheme, and I fear with such dead weight of useless capital; if the shareholders expect any dividends they will be woefully disappointed, and I would say if there is any money flowing about the Stock Exchange or in electrical circles for business of this nature, or for even incandescent electric lamp manufacture, I will undertake as an expert lamp maker to construct the finest factory, with all the necessary plant, machinery, and appliances required to turn out, say, four million of lamps a year for less than £40,000, and with £10,000 working capital as ample to carry out the objects in view, and pay good dividends on capital to this extent. Now comes the pith of the whole business, viz., the real cause and reasons why my "renewable lamps patents" were never exploited in England simply rested on one legal point. Eminent counsel's opinion was obtained prior to the registration of the "Shippey Electric Lamp Company," for under legal advice his opinion killed the whole business and covered by a few works, for eminent counsel, after complimenting my patent agents on the construction of their specification and upon the merits of the invention, his opinion was briefly as follows:—"*The very making up of an incandescent lamp of high resistance with any type of carbon filament in vacuo which could be used successfully in electric lamp circuits would be a colourable infringement of the Edison and Swan patents, no matter how the filament was made or even the class of materials used.*" Even though it was proved that royalty had been paid on same, it was considered by counsel that it would still be held to be an infringement of Edison's memorable patent, and as I was personally already legally restrained by law from making incandescent lamps of any kind of a colourable nature during the unexpired term of the Edison & Swan rights, and having already sold the patents to the present company, not a cent of the £20,000 to be paid by the promoters would have come to me for my personal benefit, and having no desire to be committed to Holloway for contempt of Court, I thought it best to take a back seat rather than run the risk or expend more money in law, having already expended over £4,000. Hence the matter fell through, and the only reason why the Shippey Electric Lamp Company was never formed; for this reason alone a valuable invention was prevented being worked, and a good and profitable business frustrated by the arm of the law, although a bitter pill for me and my then associates, that the matter fell through upon facts stated.

I enclose you copies of the specification of my patents for your perusal, which I think covers the whole ground of the subject matter under discussion; and as my patents have run through the second and third editions, it clearly shows that these inventions have interested lamp makers, although at heavy costs to me as the inventor. I must apologise for the length of this communication, but as the subject matter is one of national importance to the electrical trades, and especially lamp users, this must be my excuse for fully explaining the position of affairs, so far as it concerns my patents. If you can find space to record these facts, please do so and oblige.

Arthur Shippey.

Copper.—The *Mining Journal* says that owing to the development of the electrical industries in Germany, the increase in consumption of copper and lead appears to be greater than in any other country. In 1897 the consumption of copper was 92,148 tons, and that of lead 133,239 tons, whilst in 1898 the consumption of copper was 98,160 tons, and that of lead 159,229 tons. Germany produces 7 per cent. of the world's supply of copper, and consumes 22½ per cent., whilst its production of lead is 17½ per cent. of the world's supply, and its consumption 20 per cent.

SOME NOTES ON THE ELECTRICAL MACHINERY AT THE COMO EXHIBITION.

By KENELM EDGCUMBE, Assoc.M.Inst.C.E.

(*Continued from page* 265.)

The Technomasio Italiano had on view a number of continuous current motors in which speed regulation was performed by varying the length of air gap. Each of the two magnet limbs (the motors are of the ordinary horse-shoe type) is capable of sliding towards, or away from, the other. They are actuated by a right and left handed screw, which is turned by a hand-wheel at the side of the machine. A small pointer at the top indicates the relative separation of the poles, and hence the speed at which the motor will run. What advantages such a system possesses, as compared with the ordinary method of varying the shunt resistance, is not very clear. The alteration of speed can, of course, be made more gradual than is possible with this latter method, but on the other hand, it is necessary to go to the motor each time, instead of it being possible to have a controlling switch placed in some convenient position.

Messrs. Schuckert, among a fairly large number of machines, showed a so-called "Licht und Kraft" three-phase dynamo, which, as its name implies, is designed to supply a mixed load of power and light, without its being necessary to equalise the distribution of the latter over the three phases. The arrangement would appear to consist in running the motors off all three phases in the ordinary way, while the lamps are connected across two phases only, of the star coupled armature. As these two phases have obviously to carry more current than the other they are consequently wound with larger wire. It may be remembered that a somewhat similar system is in use at Schwytz in Switzerland, where Messrs. Brown, Boveri & Co. have adopted the expedient of joining the step-down transformers in mesh, and of connecting all the lamps on to one only of them. Messrs. Schuckert also exhibit a high tension quick-break switch for use with pressures up to 6,000 volts, in which the break takes place between a number of smooth brass cylinders, which are normally in series and touching one another, but which can be suddenly drawn apart, thus dividing the arc up into a large number of parts.

In the Dynamo Gallery was to be seen a 15-ton travelling crane, designed and constructed by Messrs. Larini, Nathan and Co., of Milan, and driven by three-phase motors built by Messrs. Gadda & Co., also of Milan. Each of the three motions is actuated by a separate motor, an ingenious device being employed in starting. Instead of the resistances being cut out of circuit by a cord or lever, a species of centrifugal governor is fixed to the motor shaft in such a way that as the latter gets up speed the switch arm is slowly moved over the resistance contacts. It will be at once seen that by this means it is merely necessary to close the motor circuit, and the maximum permissible starting torque is automatically obtained, without any fear of destroying contacts, &c. It may, at first sight, appear a needless complication to replace so simple a process as switching on a motor by one which is comparatively complicated. But when it is remembered to what rough usage a crane is ordinarily subjected, it will probably be admitted that it is a step in the right direction. Since, in the case of a three-phase motor, it is impossible to vary the speed electrically, it is in this instance done in the following manner:—The load is carried by an endless chain passing round two chain wheels, of which one revolves four times as fast as the other. For slow speeds only the latter is caused to rotate, while for high speeds (5 : 1) an electro-magnetic clutch sets the other wheel also in motion. Steel worms, gearing into phosphor bronze worm wheels, are used throughout, the thrust being taken up by ball-bearings. Extremely high efficiencies are claimed for these gears, while the commercial efficiency of the hoisting motor and tackle is said to exceed 50 per cent.

Messrs. Siemens & Halske had a fairly large exhibit of instruments, fittings, &c., of which their system of "safety fuse cartridges" may perhaps be mentioned. The objects kept in view in their design were: firstly, to produce a fuse which should act with absolute certainty on 250-volt circuits, and, secondly, to devise some means by which it should be rendered impossible to accidentally replace a given fuse by one of greater carrying capacity.

The fuse wire is wound, in two parallels, under and over radial projections. Thus, when a fuse blows, the resulting vapour is split up into six parts, so that the formation of an arc from terminal to terminal is absolutely impossible. The box containing the fuse wire is made of a special cement which, after repeated tests had been made with porcelain and other materials, was found to give the best results.

The fuses are made in various sizes to carry from 2 up to as much as 30 amperes, lead wire of the following dimensions being used:—

Amperes ...	2	4	6	10	15	20	30
Area in sq. mm.	·75	1	1·5	2·5	4	6	10

It will be gathered from what has been said that while preventing *accidental* mistakes, the system does not in any way prevent the *wilful* substitution of one fuse for another.

This same firm also shows several forms of lightning protector for overhead lines, and it may be mentioned that their now well-known "horn" type (see fig. 8) is in use throughout

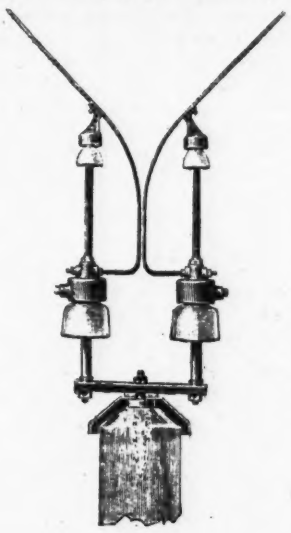


Fig. 8.

the grounds of the Exhibition, and, in fact, is to be seen on almost all the overhead lines of Northern Italy. Fig. 9 shows diagrammatically the method of connecting these protectors to a three-phase system. A is a fuse between the line and the protector, and B is a small self-induction, consisting of, say, 8 or 12 turns of cable, which is usually placed where the line enters the power station.

Of the large number of primary and secondary cells exhibited three of the former class may be briefly noticed. One of these is the "Hydra" dry cell manufactured by the Elektricitäts Actien Gesellschaft Hydrawerk, of Berlin. The chief peculiarity of this cell is that it contains a reservoir of solution, so that it never dries up, the life being thereby greatly prolonged. Prof. G. von Knorre gives the following table showing the capacity of various dry cells, tested by himself. From this it will be seen that the "Hydra" has by far the largest capacity, but as the relative weights of the different cells are not given, the comparison is not of much value:—

Type of cell.	Resistance of circuit.	Capacity in ampere-hours.			
		No. 1.	No. 2.	No. 3.	No. 4.
Liman & Obmlander ...	1 ohm.	1·703	1·721	·933	1·104
Vogt	1 „	1·180	1·165	1·511	·918
Gassner	5 „	·614	·230	·487	·321
Hydra	1 „	5·569	2·246	4·822	4·859

Messrs. Marelli showed the "Cupron" cell, which is a modification of the well-known Edison-Lalande cell, and consists of two plates of amalgamated zinc, between which is

a plate of copper oxide (CuO), the whole being immersed in a solution of caustic soda. The advantages claimed for this cell are, firstly, that it does not deteriorate by standing idle (a thin layer of oil is poured on the top of the liquid to

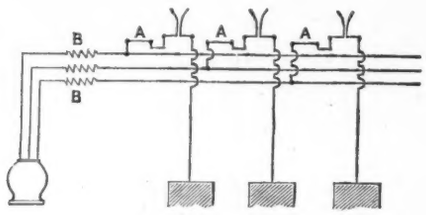


Fig. 9.

prevent the absorption of carbon dioxide from the air), and secondly, its great constancy and freedon from polarisation. The curve, fig. 10, shows the variation of voltage at a comparatively heavy rate of discharge, namely, 1·55 amperes. From this it will be seen that after the first five hours the voltage remains practically steady at ·8 volt. The high initial voltage of 1·1 is said to be due to the free oxygen occluded by the copper oxide. The capacity of the cell under these circumstances was 53 ampere-hours, while at a discharge rate of ·15 ampere the capacity rose to 60 ampere-hours. The internal resistance of a cell of this size is only ·06 ohm, and

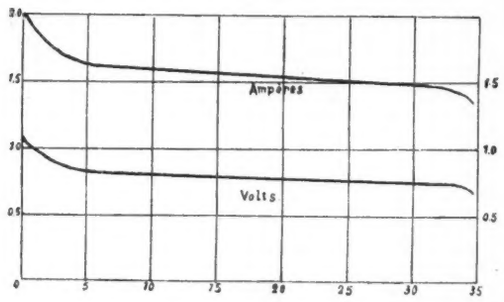


Fig. 10.

its weight 3 lbs. The consumption of zinc is said to amount to less than 2 grammes per ampere-hour, and that of the caustic soda to 4 grammes, at a total cost of about 2s. 4½d. per KW.-hour. The "regeneration" of the copper oxide takes about 24 hours at the ordinary temperature.

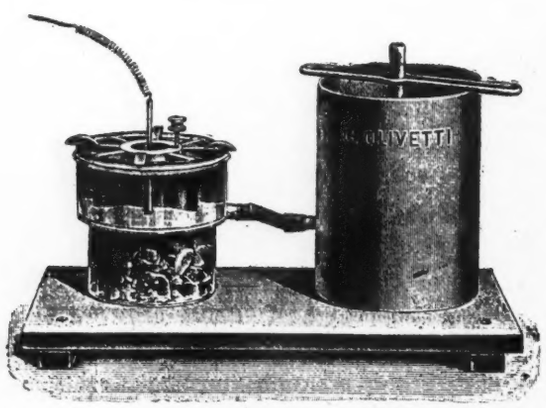


Fig. 11.

One other cell deserves mention. This is a modified Daniell manufactured by C. Olivitti, and intended especially for intermittent use. Fig. 11 shows this cell which, as will be seen, consists of two vessels connected by a short rubber tube. In the lower half of the left-hand vessel is the copper plate and copper sulphate solution, while in the upper compartment is the zinc electrode. When required for use a plunger in the right-hand vessel is lowered, thus forcing the solution it contains into the other receptacle, where it surrounds the zinc. After use the plunger is again raised, and the solution drains away from the zinc.

Among some instruments, &c., exhibited by the Museo Industriale, of Turin, was to be seen a novel device, due to Prof. Guido Grassi and Signor F. Lori, for starting single-phase motors of the Brown type. These motors, it will be remembered, require capacity in their running coils at starting, and, as ordinarily constructed, the condenser consists of a large number of parallel metal plates, dipping into a solution of carbonate of soda. It will be readily seen that for a large motor the apparatus becomes extremely cumbersome, and that short circuits are likely to occur. In the device shown by Prof. Grassi, the condenser is replaced by a simple form of Wehnelt interrupter, consisting of one or more carbon rods dipping into dilute sulphuric acid, and surrounded by a sheet of lead, forming the other electrode. The electrostatic capacity of such a cell is extremely high, and when applied to a 10-H.P. Brown motor, the starting torque was greatly in excess of that obtained with the ordinary condenser, though the latter was considerably more bulky. Further particulars of this system will be awaited with interest.

Two companies were offering power on the large scale for factories and other purposes. One, l'Elettricita Alta Italia, of Turin, supplies current partly drawn from a water-power station at a distance, and partly generated by a steam engine station in the town. The other is the Societa Generale Italiano Edison, of Milan, who receive their current from the water-power station at Paderno on the Adda. The distance is some 22 miles, a three-phase 12,000-volt transmission being employed. It may be of interest to note the charges made by these two companies. In the case of Milan, the following will give a rough idea of the cost of light and power. For light, by meter, the price is roughly 9d. per unit, with discounts of from 4 per cent. to 22 per cent. according to the energy consumed. For power, the cost of a unit ranges from 4½d. to 6d., varying, of course, with the size of meter used and with the consumption guaranteed. Thus for a 20-H.P. motor, the price per unit would range from 2¼d. to 1d., according to the number of hours run per day. Up to the present there has been no demand for current for electrolytic purposes. The company also let out arc lamps at the rate of 19s. per annum. This charge includes repairs and recarboning daily, the carbons, however, being supplied by the user.

The Turin Company supply power for small motors (up to 7 H.P.) at 1d. to 1¼d. per unit according to the consumption. For larger motors, *e.g.*, those above 50 H.P., the charges vary from £9 10s. to £7 10s. per H.P. per annum. For lighting the price per unit ranges from 8d. to 5¾d.

Of the various applications of electrical energy, one which seems so far to have received but little attention, is the electrolysis of water for the production of oxygen. Probably the chief reason for this is that twice the volume of hydrogen is simultaneously produced, and that the market for this latter gas is extremely limited. To overcome this objection, Messrs. Garuti & Pompili, of Tivoli, who are the makers of an apparatus for the electrolysis of water, are endeavouring to introduce the oxyhydrogen jet for various purposes. For its use in the various metallurgical processes the advantages which they claim are :—(1) The reduction in first cost of plant, which is said to amount to upwards of 50 per cent. ; (2) reduced loss owing to oxidation ; (3) smaller space occupied ; (4) the time taken is often reduced by one-half ; (5) the possibility of producing at will either an oxidising, reducing, or neutral flame. For welding, its adoption in place of the electric system is recommended for the following reasons :—(1) The plant required is cheaper, more portable, and less complicated ; (2) the temperature of the electric arc is too high for many purposes ; (3) it is difficult to regulate ; and (4) it is deleterious to the eyesight. It must, however, be remembered that the oxyhydrogen flame has been known for a long time, and it is doubtful whether it is merely on the score of expense that its adoption has been delayed.

(*To be continued.*)

COSMICAL MAGNETISM AND ELECTRICITY.

By ARTHUR EDGAR COTTERELL.

A very interesting article under the title of "Atlantic Earth Currents," from the pen of Mr. E. Raymond-Barker appeared in the Electrical Review on June 9th, 1899, pp. 925-6, and it has occurred to me to subject the details which head page 926 to an analysis or examination. A serial article of mine, entitled "Electric Earth Currents Viewed Astronomically," appeared in the Electrical Review in 1897 (commencing on page 527, Vol. 41, No. 1,039, October 22nd), and was followed in 1898 by another on "Terrestrial Magnetism" (which commenced on page 370, Vol. 43, No. 1,085, September 9th). In the former I endeavoured to submit a

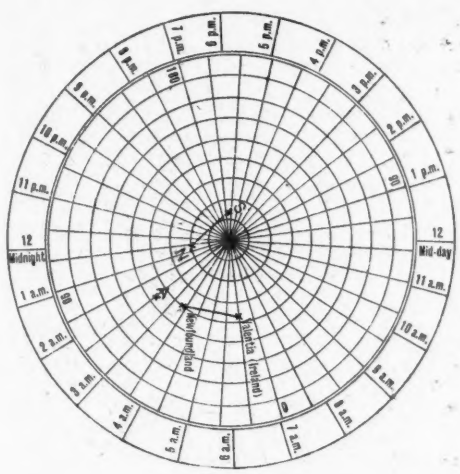


Fig. 1.

cosmical hypothesis in explanation of "Earth Currents," and in the latter I approached the question of "Terrestrial Magnetism" by asking, "Is the earth a huge magnet or merely the recipient of an ethereal line of force?" my endeavour being to substantiate the latter suggestion.

In the former articles I ventured to suggest an analogy to the dynamic production of electricity with certain celestial motions, in which the earth with a magnetic axis set eccentrically to its rotative axis formed the armature, as it were, of an immense dynamo, having the sun as its field.

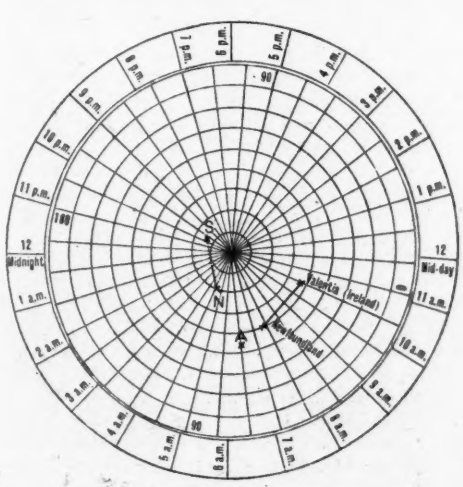


Fig. 2.

In the course of the arguments adduced I exhibited certain charts illustrative of the varying positions of the terrestrial magnetic axis in relation to the sun, which it seemed to me displayed remarkable coincidences with observed current effects as recorded at the Irish end of the Atlantic cables.

Mr. Raymond-Barker presents us with a brief summary of his records at the American side of the Atlantic, and I have ventured to apply the same to a similar analysis. The result is so very striking that I think that it is worth having attention drawn to the same. For simplicity I take the mean value of his figures from which we have the following:—

Date. 1898.	Zero.	Max. neg.	Zero.	Max. pos.	Zero.	Max. neg.	Zero.	Max. pos.
	a.m.	a.m.	a.m.	p.m.	p.m.	p.m.	p.m.	p.m.
July 14—18 ...	2.20	6.32	8.54	12.2	3.25	6.2	9.34	11.48

In order to examine the various magnetic phases as compared with the mean times above stated, let us take a chart of the Northern Hemisphere on which we must mark down the relative positions of the north and south magnetic

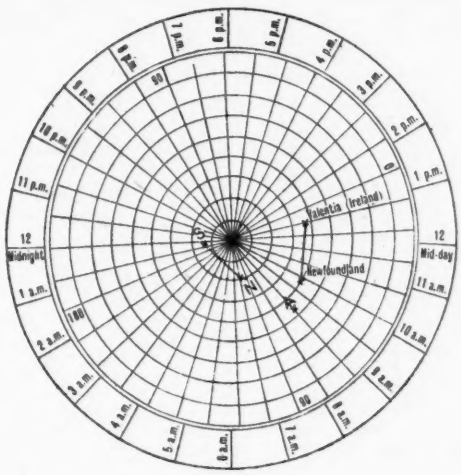


Fig. 3.

poles. This will enable us to not only see the position of the north magnetic pole, but also the relative position of the southern one.

Mr. Raymond-Barker's observations having been made on the shores of Massachusetts, we must now mark down the

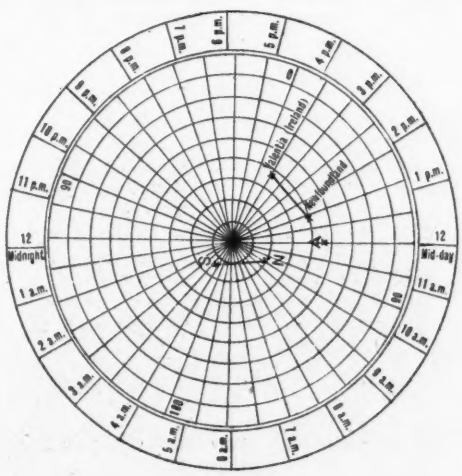


Fig. 4.

position somewhere about longitude 70° and north latitude 42° at "A." We also mark the direction of the Atlantic cable which runs more or less perpendicular to the axis of the magnetic poles, and so really forms a segment of an electro-magnetic wrapping as it were.

Around the outside of this hemisphere, we must now draw

a dial representing the 24 hours of the Solar day, the sun obviously being situated in the line of noon. If now we cut the hemisphere from the dial, and rotate the former within the area of the latter, a ready and simple comparison can be made of any desired positions.

The various positions occupied by the terrestrial magnetic axis in relation to the sun at the different mean times above stated are very full of interest, and are shown very clearly in the accompanying diagrams.

We will now proceed to turn our hemisphere with the dial to the various hours mentioned, bringing that line marked

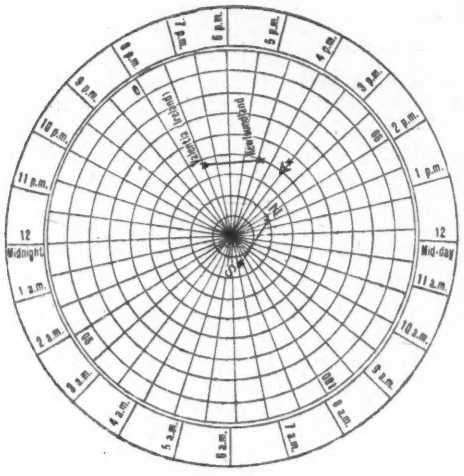


Fig. 5.

"A," and representing the American station, successively into its due positions.

First of all then (fig. 1) on turning A into line with 2.20 a.m., we notice that the north magnetic pole is at its greatest distance from the sun, which, as before stated, is in the line of noon on the dial. Next we move A forward to 6.32 a.m. (fig. 2) when the north and south magnetic poles assume a position approximately rectangular to the line towards the sun.

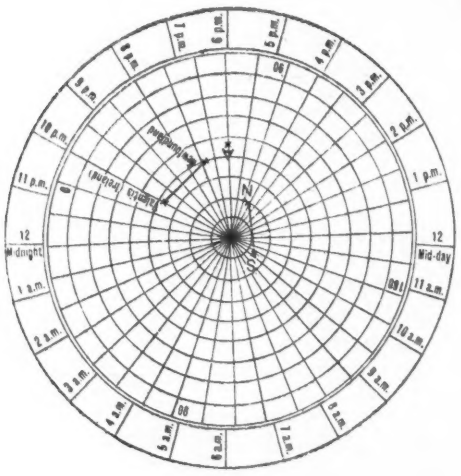


Fig. 6.

At 8.54 a.m. (fig. 3) the south magnetic pole is situated at or about its greatest distance from the sun, whilst at 12.2 p.m. (fig. 4) we notice that the north magnetic pole is very close to its nearest possible position, and the line of magnetic axis parallel to the Solar line.

At 3.25 p.m. (fig. 5) the positions are not quite so striking as those which have preceded. It must be remembered, however, that as the records were taken in July, when the inclination of the earth's axis is such that the northern hemisphere is almost at its greatest projection towards the sun, the north magnetic pole would be subjected to greater solar influences than at other seasons of the year (the Solstice, June 21st, and adjacent days, excepted). It is most interesting, however, to note that the north magnetic pole is at this time, viz., 3.25 p.m., just receding from its nearest daily proximity to the sun.

At 6.2 p.m. (fig. 6), the next position, we notice that the magnetic poles have reached their rectangular position in

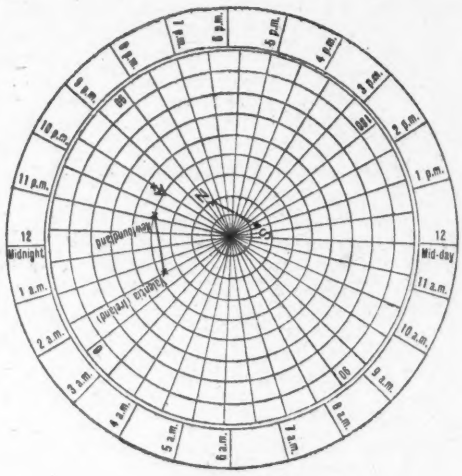


Fig. 7.

respect to the line to the sun, and in this connection it is interesting to remark that similarly with their rectangular phase at 6.32 a.m., or thereabouts, the currents are maximum negative. Turning our hemisphere again to 9.34 p.m. (fig. 7) we observe that the south magnetic pole is somewhere about its nearest position to the sun, another very striking phase.

And lastly, on bringing A round to 11.48 p.m. (fig. 8), we notice curiously enough that the north and south magnetic poles are parallel to the Solar line.

Briefly summarising these phases it may be said that :—

The maximum negative currents arise when the negative axis approximates to the rectangular position, as at about

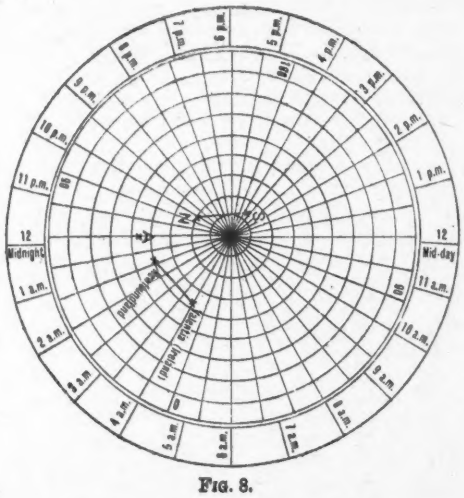


Fig. 8.

6 a.m. and 6 p.m., and the maximum positive somewhere near 12 noon and 12 midnight, when parallel to the Solar line.

The four positions when currents are zero occur when the north or south magnetic poles occupy their nearest and farthest positions in relation to the sun.

Remembering, then, that the earth's magnetic axis, which is set eccentrically to the rotation axis, must revolve around the latter, it is impossible to help being struck by the coincidence of the above-mentioned phases, and, moreover, it would seem proved that the magnetic electric relation

between the sun and the earth is of the most intimate order. The sun would appear to be quite capable of altering the earth's magnetism whether by magnetism of its own or by its heat rays.

ALUMINIUM PATENT LITIGATION.

Our Niagara Falls correspondent informs us that it is expected that the now somewhat famous suits over the patented process for the manufacture of aluminium will be heard on appeal in United States Court for the Northern District of New York, to be held in Utica, N.Y., next October, Judge Cox presiding. The case is titled the Cleveland Electric Smelting and Aluminium Company *v.* The Pittsburg Reduction Company, and is some years old. The suit is one wherein the Pittsburg Reduction Company is sued by the Cleveland Electric Smelting and Aluminium Company for alleged infringement on two patents issued about January, 1892, to Charles S. Bradley, involving, as claimed, the process practised at Niagara Falls in the manufacture of aluminium. In all there are 10 claims attached to the papers being prepared by the Cleveland Electric Smelting and Aluminium Company in the case. The patents were applied for in February, 1883, and therefore they date back to this early date as a pioneer inventor in the electric smelting field.

The nature of the claims set up may be judged from the following paragraphs taken from the patents:—

> The process of obtaining aluminium from its ores or compounds, consisting in passing an electric current through a forced portion of the aluminium ore or compound contained in an unfused body or heap of said ore or compound.
>
> The continuous process of separating or dessicating aluminium from its ores or compounds, consisting in fusing and maintaining the fusion and electrolytically decomposing the ore or compound by the passage of the electric current therethrough, and charging the pots with fresh quantities of the ore or compound as the reduction proceeds, substantially as set forth.

It is understood that these patents were purchased by the Cowles people, who are interested in the Cleveland Electric and Smelting Company, but who were then in Lockport in 1885. After their issuance from the Patent Office in 1892, a long litigation followed between the Cowles Electric Smelting and Aluminium Company and a patent lawyer in New York, Grosvenor P. Lowry by name, who had also made a purchase of the patents from Bradley, probably under the assumption that the so-called original assignment to the Cowles people was not perfect. This suit against Lowry was decided in favour of the Cowles Company, and they began the present suit against the Pittsburg Reduction Company.

In 1891 the Cowles Company sued the Pittsburg Reduction Company, under patents covering the same ground practically as those issued to the Cowles Bros., but that suit had to be withdrawn because of the Bradley patents, bearing an earlier date of application than the Cowles patents, issuing from the patent office and assigned to Lowry, who was then the American representative of the great aluminium company at the Falls of the Rhine, in Switzerland.

Charles M. Hall, the inventor of the process now used by the Pittsburg Reduction Company, is now with that company at Niagara Falls. It is said his early experiments were carried on in the Cowles plant then in operation in Lockport, N.Y. In 1892 the Pittsburg Reduction Company sued the Cowles Company under a patent that Mr. Hall secured. On trial the United States Court in Cincinnatti construed the Hall patent very broadly, and enjoined the Cowles Company from continuing the manufacture of aluminium, since which time their plant in Lockport has been closed. This suit has not as yet reached an appeal.

The process of making aluminium consists of fusing the materials from which the aluminium is produced in a large iron tank open at the top and lined over the bottom by a heavy mass of carbon. The electricity passes into the material fused by means of a number of heavy carbon rods 3 or 4 inches in diameter, the ends of which hang down into the liquid bath. The aluminium is deposited very much the same as nickel is deposited by electrolysis, and collects as a mass of molten metal below the fused bath of aluminous material. No heat but that evolved from the electric current is used.

As the litigation is already extended, the outcome of the suits will be watched with much interest at home and abroad.

EFFICIENCIES.

One of the evil effects of published tests is the use made of the figures obtained. It is well known that under carefully conducted tests a machine, or other appliance, will produce results that cannot be obtained in every-day work. This is particularly noticeable in stoking. Under the spur of some temporary incentive a stoker will secure results very much superior to his every-day work, and he will do it without actually knowing that he is doing beyond his average. A continual incentive cannot be maintained except by financial pressure in the shape of a bonus. When a bonus can be earned, and where an addition to the weekly earnings is particularly desirable, much may be done by the use of such instruments as a water-meter or the newer econometer. We have known in a steel works where the appearance of the chemist with his apparatus at the gas producers has at once improved the gas which was being produced, simply because the attendant knew that tests would reveal the degree of attention given to the furnace. All machines, be they engines, turbines, pumps, or boilers, have certain known efficiencies. The maximum efficiency ever obtained is known to some degree of approximation, and there is a tendency to use such maximum record in designing new plant, with the result that every detail of a new plant is probably proportioned to some maximum figure which is little else than ideal. If every item in a chain of machinery were thus designed, perhaps one might reach the efficiency alloted to it, and the remainder might fall short to an amount up to 10 or 20 per cent. In electrical transmission work, between the coal heap and the motor spindle, there is a chain of seven links, viz., a boiler, a steam engine, dynamo, step-up transformer, line, step-down transformer, and motor, the maximum efficiencies of which, may, for illustration, be assumed to be 75, 90, 95, 95, 90, 95, 80. The product of these efficiencies is 41·6.

Let each of the efficiencies fall off by the small amount of 2 per cent., and the final efficiency will be 34·8, or less than 84 per cent. of the first product. In other words, if a steam engine of about 840 H.P. was originally designed, the small average reduction of 2 per cent. in the efficiency of each link in the chain would demand an engine to be employed of about 1,000 H.P. Assuming the 840 H.P. engine to have been built to work at its maximum efficiency, it will be overloaded if worked up to 1,000 H.P., and all through the chain each link will be too small for the duty placed upon it, with the result of excessive depreciation and wear. The practical designer, who knows how far below the best results are the efficiencies secured in daily work, will provide for such by assuming what we may term the efficiency of the efficiencies. In a chain of efficiencies such as given above, the mean of the seven efficiencies is 88·5 per cent. If the product of the seven efficiencies or 41·6 be multiplied by this eighth efficiency, the final product is 36·8, or not seriously greater than the number 34·8 found by assuming a slightly reduced efficiency in each element. Investigated mathematically, the variation of the different efficiencies might perhaps be determined in respect to the relative probability of each variation, and the efficiency factor might be some figure more or less than the arithmetic mean we have employed for illustration. But it is extremely improbable that the probabilities of variation from the maximum could really be established with any marked accuracy, seeing that such factors enter into the problem as the personal equation of a stoker, and the behaviour of a long line of transmission in all kinds of weather, and the experiences of practice would seem to be met by using a final multiplier derived from the average value of all the efficiencies in the chain. Probably there are not sufficient existing data from which to estimate how far actual efficiencies fall below test values. Calling the various efficiencies in the chain $e_1, e_2, \ldots . e_n$, the mean efficiency suggested above is

$$\frac{e_1 + e_2 + \ldots . e_n}{n} = \text{E},$$

the efficiency of the efficiencies. Should E, as thus found, prove to be too large a number, it would probably be sufficiently corrected by a constant, becoming $\text{E} - c$, where c is such a constant as a few practical trials showed to be necessary. c would obviously be a variable constant according to the probable nature of the plant, the attention likely to be bestowed upon it, its size, and importance. The effect of such a constant, substractive from the mean of the efficiencies, would be relatively greater in the case of a short chain than in a chain of many links. This is as it should be, a chain of few links being more affected by an abnormally low efficiency in one link than would be a longer chain, and this risk the constant would tend to eliminate with greater effect in the fewer links. In any assemblage of machinery there is almost a certainty of some one item being below expectation, either from inherent fault or from misproportion, whereby it is unable to work at its most efficient rate, and it is never safe to take a series of maximum efficiencies as the probable efficiency basis for the whole plant under the idea that, while some of the items will fall below the test efficiency, others will exceed their expected efficiency. Practice does not bear this out.

Where machinery is specially devised to be at times worked at part power, as turbines at part gate, or throttled centrifugal pumps, the item efficiencies to be taken as factors in the continued products for efficiencies must not be the maximum, or test efficiency, of the turbine, for instance, at full gate, but its test efficiency at such part gate. This is especially necessary in case of hydraulic machines of which the efficiency falls off so rapidly at part gate. In trying the method suggested above upon an example recently encountered, we find that the efficiency of a combination actually obtained accords very closely with the results given by the method.

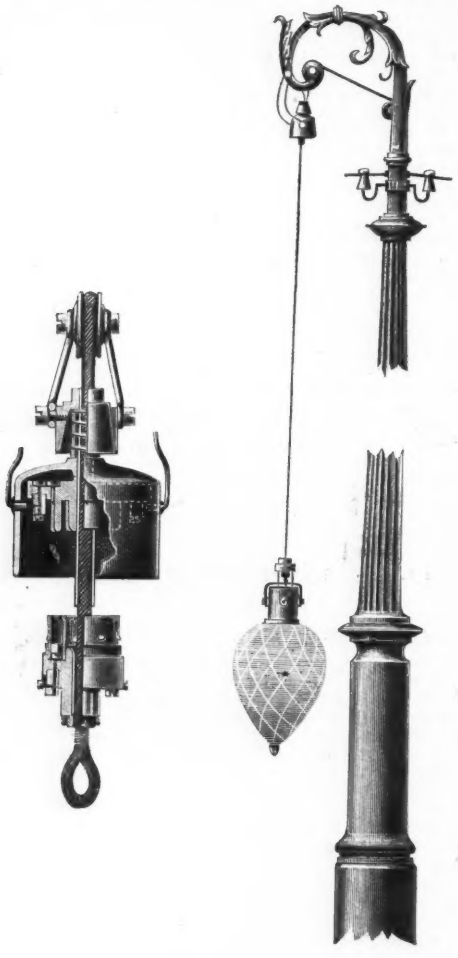
BUSINESS NOTICES, &c.

Accumulators in France.—A new company has just been formed at Clichy with a capital of £22,000 to be known as La Société Nouvelle de l'Accumulateur Fulmen.

Anglo-Swiss Trade.—A report has been prepared by the British Legation in Berne, proposing a scheme for the increase of trade between Great Britain and Switzerland. The establishment at Zürich, the commercial centre of Switzerland, of an Anglo-Swiss chamber of commerce with a depôt of samples of British goods is proposed.

Arc Lamp Coupling.—Mr. G. Braulik is placing upon the market a new coupling for arc lamps, by the use of which it is claimed that the unsightliness caused by lengths of conducting cable having to hang down is obviated. Counterweight methods are

asserted to have rendered handling of the lamps a more complicated process as well as endangering the insulation of the cable. Mr. Braulik's coupling, which is shown in the illustration (fig. 1) can be fitted to existing arc lamps (fig. 2). It is said to be suitable for all installations, and to be specially adapted to high tension. It consists of two contact boxes, one fixed for fitting on the roller where the lamp is to hang, and a movable one attached to the lamp. The contact springs are so arranged that all these parts are fixed on the lower plug for easy examination when the lamp is receiving attention, while on the top part they need not be so accessible, only a solid contact ring being used. The contact parts consist of solid metal rings with springs; the rings lie concentrically one in the other, so that swinging or turning the lamp does not break contact. The conducting



tube in the top part is insulated from the lower plug, so that any moisture that may drop from the cable used for raising the lamp does not touch conducting parts. The suspending cable goes through the whole of the coupling to ensure a meeting of the two contact boxes. All current-carrying parts are well mounted and highly insulated with porcelain, and protected from the weather by a solid cap. The apparatus, when hung, is supported by a spring, and pressure does not fall on the contact springs, nor are they affected by jolting. The fitting is hung by fixing a hook on the axle of cable roller, while the lower part with screws are fixed through the terminals on to the cable. In lowering the lamp, current is switched off, as by a double-pole switch, and shock accidents are impossible.

Bankruptcy Proceedings.—Mr. Sydney F. Walker, electrical engineer, Cardiff, filed his petition in bankruptcy on Thursday last week. It is said that the liabilities will not exceed £2,000.

Liquidations, Dissolutions, &c.—The Electrical Pioneer Syndicate, Birmingham, is winding up voluntarily, Mr. A. H. Gibson, 39, Waterloo Street, Birmingham, being liquidator. Creditors must send particulars of debts, &c., to Mr. Gibson by October 31st.

Creditors of the London and Lancashire Electric and General Engineering Company must send particulars of debts, &c., to the liquidator, Mr. F. A Franklyn, 48, Upper Thames Street, by September 30th.

Catalogues, &c.—Messrs. Baxendale & Co., of Manchester, send us illustrated price lists of switch blocks, pendants, brackets and other electric lighting and bell accessories, also the "Saxon" enclosed arc lamp.

The Bullock Electric Manufacturing Co., of Cincinnati, U.S.A., sends us a pamphlet in which there are described and well illustrated the Bullock engine type of generators. The various parts, field coils armature, armature coils, yoke, and a Bullock generator direct connected to a gas engine are illustrated, and an efficiency curve of a 200 KW. machine is included. There is a table of dimensions and code words.

Electrical Engineering in Sweden.—The Swedish State Railway Authorities have placed a contract with Messrs. Siemens & Halske for the establishment and equipment of electrical power stations at Abiskojokk and Kadeyokk, near the new railway between Gellivaia and the Norwegian frontier.

Infringement of Patent.—Judgment was given some days ago by Lord Justice Romer in the case of the British Motor Syndicate, Limited, and the Great Horseless Carriage Company, Limited, *v.* J. E. H. Andrew & Co., Limited, which was an appeal against a decision of Mr. Justice Kekewich. According to the *Times* report the plaintiffs, as the registered proprietors of letters patent (No. 5,479 of 1890) granted to Frederick William Lanchester for "improvements in gas motor engines," brought the action to restrain the defendants from infringing the patent. Mr. Justice Kekewich held that there had been no infringement, and he dismissed the action with costs. The decision was based on the ground that the patentee had by his specification claimed only his main method of carrying out his invention, and not two subsidiary methods. The defendants had raised the other objections usual in patent cases, such as "disconformity," anticipation, and want of subject-matter. The plaintiffs appealed. Mr. Moulton, Q.C., Mr. T. Terrell, Q.C., and Mr. A. J. Walter were for the plaintiffs; Mr. Crippe, Q.C., and Mr. J. C. Graham were for the defendants. The appeal was heard in July, when the Court reserved their judgment. Last week the Court allowed the appeal. His Lordship discussed the nature of the subsidiary methods, and then proceeded to consider the points taken by the defendants. With regard to the point on which the defendants succeeded in the Court below, his Lordship said that it was too narrow a construction to be placed on the specification. The patentee in the body of the specification clearly referred to the subsidiary methods, and intended them to come within the scope of his invention. His Lordship added that the wording of the first claim covered the subsidiary methods. This objection, therefore, failed, as also did the contention founded upon it that there had been no infringement by the defendants, because in their machine the flame does not strike back in the precise way covered by the patentee's main method. His Lordship then discussed other objections taken by the defendants, all of which he overruled, and concluded that the plaintiffs are entitled to succeed. He granted an injunction restraining the defendants from further infringing the plaintiffs' patent, and ordered an inquiry as to damages. The plaintiffs were granted their costs here and in the Court below, including the costs of the particulars of breaches.

Recent Motor Wagon Trials at Liverpool.—It may be noted as a fact of some importance that the second series of trials of heavy traffic vehicles held at Liverpool early in August, included no vehicles except such as were steam-driven either by oil or coke fuel. It appears that the winner in the first series of tests in May, 1898, namely, the Leyland vehicle, only received a silver medal this year, the winning vehicle being in both classes a Thorneycroft vehicle from Chiswick. Progress has evidently been made, for the trials this year not only included the same routes of 30 miles each as the trials of last year, but also some special hill climbing and descending trials, comprising gradients as steep as 1 in 9 upon very rough paving. The larger Thorneycroft wagon is said to have done specially fine work with a full load of 6½ tons carried up and down hill on a rutted road. On the long distance runs also the Thorneycroft vehicles did well, averaging 5 miles per hour. It appears to us that the motor vehicle industry is now fairly established, and that very soon considerable numbers of vehicles will be seen at work. We also anticipate a considerable crop of very serious accidents. Without a horse in front to push a person out of the way, these heavy motor vehicles have their leading wheels well thrust out in front and absolutely devoid of safeguards of any sort. To be run over by a heavy motor car will be as bad as to be run over by an electric tramcar, yet the latter are compelled to provide safeguards and the former have absolutely nothing, and come quietly upon a foot passenger from unexpected quarters and in diagonal directions, whereas an electric car does run on a recognised track. The motor van, or vans, of Messrs. W. H. Smith & Son are particularly noticeable in London as presenting the dangerous appearance above noted, in conjunction, we may add, with not too careful driving. We certainly think wheel guards should be provided by compulsion. It would be easy to do this, and the absence of such guards will cause accidents that may give another set back to the motor-car industry, accidents which, in the mind of any sensible juryman would, we hope, exercise a salutary effect on the "damages," while a coroner's jury, in our opinion, would rightly give its verdict in a fatal accident as one of manslaughter against those responsible for the deficiency.

Water Level Indicators.—Messrs. John Hopkinson and Co., Limited, of Huddersfield, have recently published a treatise on the "Indication of Water Levels in Steam Boilers," having special reference to water gauges fitted with automatic valves. The liability of gauges to indicate false water levels is pointed out, and Hopkinson's patent "Absolute" water gauge is suggested as a means for preventing this. This gauge is described and beautifully illustrated in the list before us. A serious form of accident which may arise where gauge plugs are blown from the body of the gauge is mentioned, together with a suggested remedy against accidents arising from this cause. After 27 pages of matter of this description, which is accompanied with several sketches, a list of prices of the various sizes and patterns of water gauges is given.

Electrical Wares Exported.

Week ending Aug. 23rd, 1898.		Week ending Aug. 22nd, 1899.	
Albany	Value £16	Amsterdam	Value £20
Amsterdam	115	Auckland	75
Bangkok	20	Beira	1,377
Boca	37	Bombay	69
Buenos Ayres	198	Boulogne	25
Calcutta	121	Buenos Ayres	2,307
Cape Town	144	" Teleg. mat.	155
Chinde	941	Cadiz. " Elec. machinery	240
Christiansande	16	Calcutta	75
Copenhagen	65	Christchurch	12
Durban	58	Colombo	498
East London	85	Delago Bay	59
Fremantle	36	Durban	710
Gibraltar	600	Fremantle	105
Hamburg	380	Grenada	918
Launceston	7	Havana	20
Malta. Teleg. cable	120,000	Hiogo. Teleg. mat.	118
Melbourne	588	Liban	93
Ostend	176	Malta	10
Perth. Teleg. cable	664	Melbourne	60
Port Elizabeth	1,517	" Teleg. mat.	2,193
Rangoon	36	Odessa	15
Stockholm. Teleg. wire	125	Ostend	148
		Penang	15
		Port Elizabeth	142
		" Teleg. wire	483
		Rio Janeiro. Teleg. mat.	1,424
		Rotterdam	20
		San Sebastian	35
		Santos	20
		Singapore	107
		Stockholm. Teleg. wire	161
		Sydney	1,548
		Wellington	46
		Yokohama. Teleph. cable	95
Total	£125,940	Total	£12,693

Foreign Goods Transhipped.

Melbourne .. .. .. Value £89 | Calcutta. Elec. supplies.. Value £64

Orders Revoked.—The Board of Trade have given notice that they have revoked the Waterford Electric Lighting Order, 1892, and the Kilkenny Electric Lighting Order, 1892.

Testing Batteries.—Messrs. Niblett & Sutherland, of Chandos Street, W.C., have recently introduced some new forms of portable storage testing batteries. A battery giving 500 volts was recently supplied to the Liverpool Corporation Tramways. A smaller set is the ordinary pattern testing battery which gives 100 volts. It is considered that to those who are accustomed to the ordinary forms of testing batteries the size and weight will come as a revelation. As an illustration of the current-giving capacity of the batteries, the 500-volt battery mentioned was tested and ran five 100-volt 16-c.p. lamps placed in series, fully incandescing them for some considerable time. The total weight of the battery in question is only 50 lbs., and it is quite portable and can be handled with ease. For convenience of recharging, every battery of this type is divided into two sections, and is so arranged that these two sections can be placed in parallel or in series by means of an ingenious switching device with which it is fitted. In the construction of these batteries no soldered or burnt lead connections are used between cell and cell, so that trouble from defective connections is entirely obviated, and as a mechanically solid diaphragm is used as a separator, internal short circuits are prevented. The internal resistance is so small that, as has been previously stated, an 8 or even a 16-c.p. lamp can be run from them, thus rendering the batteries useful for making continuity tests as well as the usual insulation tests. The 100-volt battery only weighs 14 lbs., and when the two sections of the battery are placed in parallel it can readily be recharged through, say, an 8-c.p. lamp on a 100-volt circuit. It is obvious that anyone about to use this battery for a test would naturally insure its being full by previously giving it a recharge, but the local action in the cells is so small that the batteries have been known to hold their charge and give their full potential after standing idle for over a month. Messrs. Niblett & Sutherland have supplied quite a number of these batteries, ranging in voltage from 100 to 500 volts, to various corporations and central stations. Among these may be mentioned the Charing Cross and Strand Supply Company, the British Electric Traction Company, the British Insulated Wire Company, the Belfast Corporation, &c.

Tests of Electric Light Engines.—From copies of tests made at Morley, by Mr. Hammond, upon some non-condensing engines of Pollitt & Wigzell's make, and at Bath upon the same firm's condensing engines, in each case fly-wheel alternators being driven, we find the following results:—The non-condensing sets are 125 kw., with horizontal engines having high-pressure cylinders, 14 inches; low-pressure, 23½ inches; stroke, 30; speed, 100; pressure, 130 lbs. The cylinders are side by side with fly-wheel alternator between, Corliss valves with trip gear. The alternators generate at 2,000 to 2,200 volts, and are 13 feet diameter over poles, and weigh 10 tons. The efficiency is 82 per cent. The steam consumption was 35½ lbs. per kw.-hour average of the two sets. The running was perfectly steady without vibration, and the governing good. At Bath, the engines are vertical, with cylinders 17 inches and 34 inches by 30 inches stroke at 124 revolutions with 150 lbs. pressure, these also have Corliss valves with trip gear. The fly-wheel alternator is 15½ feet diameter over poles, and weighs 12 tons. The efficiency is 82 per cent., as at Morley, for the combined plant. The boilers are water-tube type. Water was measured in a tank, and showed 24 lbs. per kw.-hour for one set, and somewhat less for the other set, the i.h.p. averaging 480, and the steam per i.h.p.-hr. 14·45 lbs. The results of all these English engines are very good, better, we think, than are obtained with most of the foreign made engines so far sent to England. But we must not despise the foreign made engine. It has kept us going in England when our own makers have been too busy—too saucy, a steam user puts it—to give any attention to the would-be purchaser. Patriotism is a good virtue, but it is apt to wear thin when asked to wait a year for a small steam engine.

Trade Announcements.—Mr. Carl Quiltmann, electrical importer, has removed from 17, Jewin Crescent, E.C., to 3, Cloth Street, Aldersgate Street, E.C.

Messrs. Wm. Coates & Son, Limited, have opened premises at 5, Leinster Street, Dublin, as electrical engineers, contractors, &c., and have appointed Mr. Martin Olsson, A.M.I.E.E., resident engineer.

The "Vril" Launch.—On the occasion of the Prince of Wales's recent visit to Cowes, H.R.H. having heard of the merits of the "Vril" launch as supplied by Messrs. Laing, Wharton & Down, Limited, issued instructions for one of these boats to be submitted for his inspection. The launch, which was 28 feet in length, was sent to the Royal yacht *Osborne*, and the Prince then gave orders that it should cruise towards the *Meteor*, whither the Prince went in his steam launch, accompanied by the Duke of York, Admiral Stevenson, and Capt. Fortescue. The party then inspected the performance of the boat from the deck of the *Meteor*, and the Prince was so pleased with it, that he afterwards, together with the others, boarded the boat, and went for a cruise round the fleet. Subsequently the chief engineer of the *Osborne*, Mr. Babb, went on board the boat, and made some suggestions which will doubtless prove of considerable value. The Royal party afterwards expressed great pleasure at the trip.

Water-tube Boilers.—We understand that the patent rights outside the United States for the Morrin "Climax" water-tube boilers have been acquired by Messrs. B. R. Rowland & Co., of Exchange Street, Manchester, which firm is now manufacturing the "Climax" boiler in this country. It may be mentioned that seven of these boilers of 500-h.p. and two of 600-h.p. are used at the works of the People's Light and Power Company, New Jersey.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The Harbour has been equipped with 60 arc lamps on posts 25 feet high and 40 yards apart, arranged on two circuits, as well as with three beacon lights, each consisting of four arcs on a post 80 feet high. The lamps and posts were supplied and erected by Messrs. Lucy & Co., Oxford, at a contract price of £2,110; the mains have been laid by the Corporation at a cost of £5,000. The annual cost is estimated at £1,700. It is expected that the supply will be begun in a few days.

Banbury.—The Council has referred to the General Purposes Committee a recommendation made by another Committee that the town clerk take steps to obtain a provisional order for electric lighting.

Barnstaple.—The Town Council has resolved to apply to the Board of Trade for a provisional order for electric lighting.

Bermondsey.—The Vestry clerk has issued a circular pointing out that the Vestry has obtained an Act of Parliament authorising the Vestry to supply electrical energy; the system decided upon is low tension continuous current.

Bridgend.—The intention of the Council to transfer its provisional order to the English Industrials, Limited, is filed in the usual way in the *London Gazette* for August 18th.

Brighton.—The Local Government Board has given its sanction to the loan of £64,000 for 24 years for purposes of electric lighting.

Chadderton.—The District Council is considering the question of obtaining powers for the electric lighting of the district.

Cleckheaton.—The District Council is taking steps towards obtaining a provisional order for electric lighting.

Colchester.—An inquiry was held on August 16th by Mr. E. S. Fawcett, for the Local Government Board, into the application of the Corporation for leave to borrow £6,500 for electric lighting; this is in addition to a loan of £14,900, sanctioned in February, 1897. The present plant is capable of supplying 4,250 8-c.p. lamps; the new machinery is to consist of a 350-h.p. engine, coupled to a Siemens dynamo.

Dewsbury.—At a meeting of the General Committee of the Co-operative Society last week, it was resolved that on account of the heavy charges for the supply of electricity by the Dewsbury Corporation, the time had arrived to put down a plant for the purpose of generating electricity on the premises. The society's electric lighting bill at the Central Stores for the year ending June last was no less a sum than £508! The society has at present about 1,100 lights at the Central Stores.

(*Continued on page* 321.)

WEST HAM ELECTRICITY WORKS.

THE question of electric lighting in West Ham first assumed practical importance early in 1896; Mr. G. H. C. Risch was appointed electrical engineer by the Corporation, and prepared a scheme to cost £67,000. Mr. Risch, however, was obliged to resign his post six months later on account of ill-health, and Mr. J. J. Steinitz, then at Leicester, was appointed in his place. A new scheme was drawn up by Mr. Steinitz, and after a Local Government Board inquiry in November, 1896, a loan of £50,000 was authorised. Before the completion of the works further loans of about £14,400 were also sanctioned, for the lighting of public buildings and other purposes.

Supply was begun on December 10th, 1898, but it was immediately found that extensions were necessary, and a further expenditure of £51,000 was decided on. It was in connection with the contracts for these extensions that a difficulty occurred, which aroused the interest of the whole industry. The Corporation insisted on the insertion in the contracts of a so-called "fair wages" clause, which was, to use a Hibernicism, more fair to the workmen than to the employers; the contractors, Messrs. S. Z. de Ferranti, Limited, refused to accept these conditions, which constituted a subversion of the settlement arrived at as the result of the engineers' strike, and after a stiff fight Messrs. Ferranti gained their end. The present capacity of the plant is 700 KW., but so bright are the prospects of the undertaking, that two additional steam alternators of 2,400 KW. joint capacity were put in hand, and the sum of £29,000 was voted for extensions to the mains.

The generating station is situated close by the Abbey Mills pumping station, one mile from the Stratford division of the borough and two miles from the Canning Town district. The station was built by Messrs. Gregar & Sons, Stratford, under the supervision of Mr. J. G. Morley, deputy borough engineer, and includes, in addition to the electrical works, a large pumping station in connection with the sewerage system.

The electricity works comprises a dynamo and engine room, pump room, workshop, various offices and storerooms, drawing office (also used as testing room), and a share in the boiler house, which is common to the pumping and electricity departments. A neat telephone switchboard provides ready means of communication between the works and various Corporation offices in the borough.

The boiler house, 129 feet by 47 feet, contains at present nine Lancashire boilers, made by Messrs. Spurr, Inman and Co., Limited, of Wakefield, working at a pressure of 120 lbs. per square inch. Each boiler is 30 feet long, by 7 feet 6 inches in diameter, and is capable of evaporating 10,000 lbs. of water per hour. The boilers are fitted with automatic stokers made by Messrs. Bennis & Co., Limited, Bolton. These are fed by their patent chain conveyor and an elevator, which raises the coal from the coal stores through a height of about 60 feet. The coal is scattered by the stoker over the whole surface of the grate. The latter is of Messrs. Bennis's new compressed air type, in which air is blown into each bar with great force, ensuring perfect and smokeless combustion. The makers claim that by this means the nine boilers are enabled to do the work of 16 hand-fired boilers, while two men are able to attend to the whole range.

A Green's economiser, consisting of 384 tubes 4 inches in diameter by 9 feet long, is fitted in the main flue, with the usual bye-pass. The shaft is 150 feet high, 8 feet diameter inside, lined with firebrick to a height of 56 feet, and is much more handsome, or, rather, less unsightly, than such structures usually are.

As will be seen in our illustration of the boiler house, the conveyors are not quite complete. This explains the presence of the coal heaps. In future the coal, which is brought up the Channelsea River in barges, will be delivered direct into the underground coal stores by a steam crane on the wharf.

In addition to the boilers described above, the foundations are laid for three water-tube boilers, each capable of evaporating 15,000 lbs. of water per hour, which Messrs. Babcock & Wilcox, Limited, have in hand. These will be fitted with their patent chain grate stokers and superheaters. The same company, which supplied the whole of the steam and feed piping already installed, has also on order three of its patent purifiers; two sets of surface condensing plant of Messrs. W. H. Allen, Son & Co.'s manufacture, capable of dealing with 20,000 lbs. of steam per hour; two Weir feed pumps, and the necessary steam, exhaust, and feed pipes. There are at present in use two feed pumps of Messrs. G. and J. Weir's standard type which draw from a feed water tank, 4 feet by 6 feet by 22 feet, in the pump room, through coke filters, and deliver to the boilers through another filter under pressure. The pumps are of the vertical double acting type; the dimensions are 7 inches diameter, 18 inches stroke, and they are capable of discharging against a pressure of 180 lbs. per square inch. As the East London water is hard, an Artesian well has been sunk to a depth of 450 feet, and is now being tubed; an ample supply of water for condensing is obtained from the canal close by.

The pump room contains, in addition to the feed water tank, one of Messrs. W. H. Allen's surface condensers of the marine type, having a tube surface of 1,000 square feet, and capable of condensing 12,000 lbs. of steam per hour. The air and circulating pumps are built up with the condenser, as will be seen in our illustration of the set. The air pump is single acting, 16 inches diameter by 8 inches stroke; the circulating pump is double acting, 12½ inches diameter by 8 inches stroke. India-rubber valves are used. The pumps are driven by a vertical compound engine, 9 and 14 inches by 8 inches stroke, running at 120 revolutions per minute, with fly-wheel.

The steam pipes are of mild steel, duplicated as far as the engine room but single to the engines, and are fixed with the exhaust pipes beneath the floor of the engine room, which is of York stone carried on steel joists, and cellared 8 feet deep; by this means the pipes, steam traps, &c., are kept out of sight, while the electrical connections and the lower portions of the alternators are readily accessible. The steam traps are of the Geipel type, one to each set, and the separators by Messrs. Holden & Brooke, of Manchester.

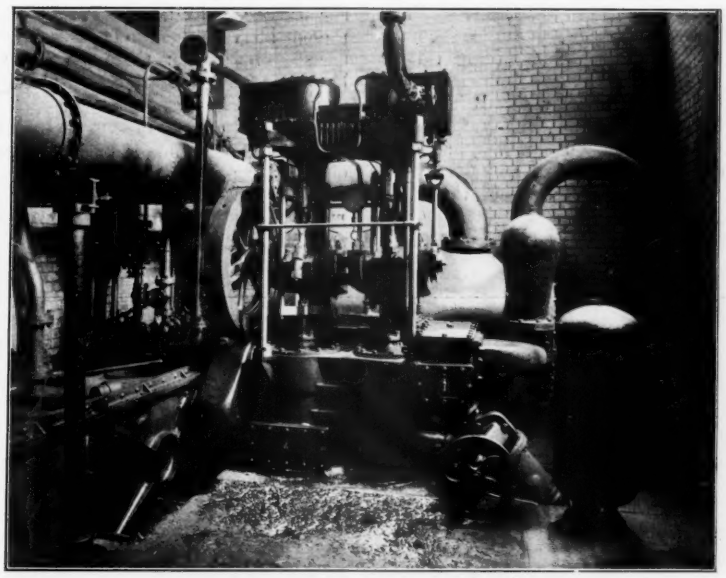
The engine room is 82 feet long by 42 feet wide, and contains ample room for the additional machinery which is on order.

The generating plant consists of one 100-KW. and three 200-KW. steam alternators, made by Messrs. Ferranti, Limited; our bird's eye view shows the general arrangement of the plant, which is very compact, while another illustration includes the front view of one set and the back view of another. The engines are compound, with cranks at right angles, and are fitted with Ferranti's patent valve gear, with separate balanced steam and exhaust valves; the high pressure valve is controlled by the governor, while the low pressure cut-off can be varied by hand while the engine is running. The receiver, which forms the connection between the cylinders, is provided with a superheater fed with live steam; means are also provided for admitting live steam to the low pressure cylinder for starting. Forced lubrication is employed throughout, and the governor is provided with a separate oil pump; there is also an auxiliary oil pump, which may be worked by hand. The oil is circulated through a filter, which is seen in the illustration standing on the ground near each engine. Outside the main bearing, next the alternator, a roller bearing is fixed, the upward pressure of which is adjustable by means of coiled springs, to assist the main bearing; this fitting may also be used to lift the shaft and armature clear of the main bearing, should it be desired to remove the latter.

The alternators, which work at 2,100 volts, 250 revolutions per minute, are of the usual Ferranti air core type, the coils being mounted on porcelain insulators round the circumference of a fly-wheel about 6 feet in diameter, and weighing 9 or 10 tons. They run quite silently, and work perfectly in parallel, while they are able to withstand a heavy overload without overheating or any other injurious effects being met with. The two opposing sets of field magnets can be drawn back simultaneously by a right and left-hand screw at each end, the whole operation being performed by means of chain and worm gearing from one point. One terminal of the armature is connected with an insulated slip ring; the other is earthed to the frame, and the connection made by brushes bearing on the internal periphery of the fly-wheel. The exciters are of Messrs. Thos. Parker's hinged-pole type, with Eickemeyer windings, and are driven by ropes from the alternator shafts.

The switchboard is of Messrs. Ferranti's standard pattern,

and is at present arranged for four alternators and four feeders, two to Stratford and two to Canning Town. All the switches are in series with the inner conductor of the concentric cables, the outer being earthed. There are two Kelvin voltmeters, made by Messrs. White, of Glasgow, reading from 1,900 to 2,200 volts, and a Hartmann and Braun hot-wire voltmeter with open scale at 100 volts. A synchronising transformer is fixed over the switchboard. The ammeters are of Messrs. Ferranti's edgewise type, with ranges varying from 50 to 150 amperes. The exciting current is controlled by Siemens regulators, with Nalder ammeters. The small space occupied by the switchboard is well seen in our general view. A Thomson-Houston watt-hour meter is placed in series with each feeder.

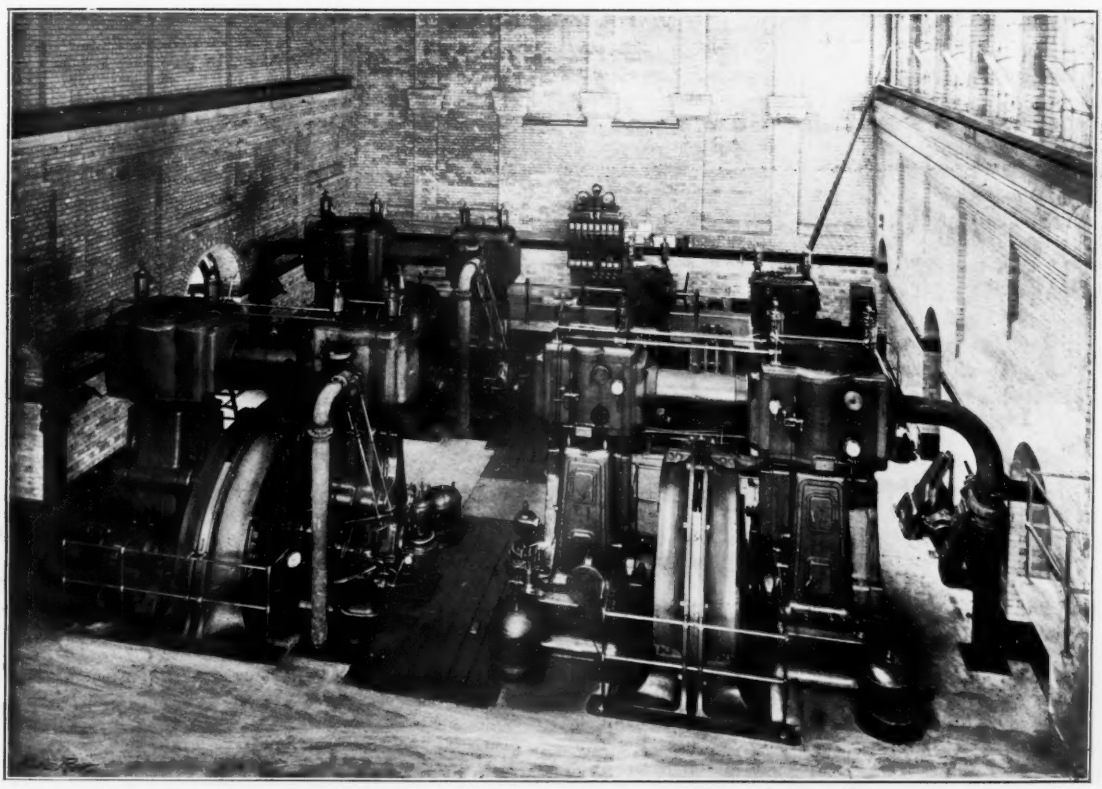


West Ham.—Condenser and Pumps.

A 10-ton travelling crane, made by Messrs. Taylor and Hubbard, of Leicester, traverses the whole length of the dynamo room.

Extreme care has been taken in the design of the sub-stations to ensure safety to the operators; the high pressure chamber is separate from the low pressure, and no one is allowed admission to the former except in the presence of the chief engineer or the foreman of mains.

The principal sub-station is in the basement of the Stratford Town Hall, and contains at present two 30-KW. transformers; two more are to be added shortly. There are two main feeders direct from the works to the sub-station; any transformer can be switched on either of these. A maximum demand indicator is placed in circuit with each transformer, and a Pitkin recording voltmeter is connected between the low pressure bus bars. The high pressure switchboard provides for five feeders to street transformer boxes, which can be switched on either of the main feeders; a Nalder ammeter is in series with each feeder. Two of these feeders run to the Empire Theatre, where 2,000 lamps are installed.



West Ham.—General View of Generating Plant, from Crane.

The distributing system is carried out by means of sub-stations and street transformer boxes; the whole of the latter, and the switching gear in the sub-stations, were made by the Brush Electrical Engineering Company, Limited. All the conductors in the sub-station are painted, the inners red and the outers black, to distinguish them from one another.

The arc lighting switchboard is so arranged that it can

be operated from the low pressure chamber, by means of insulated handles passing through the wall; there are six arc circuits, feeding about 60 lamps in all. A Shallenberger meter is placed in each circuit.

The sub-station at the Public Hall, Canning Town, is generally similar to the one described above, but has only four arc circuits, feeding 30 lamps. There are three other sub-stations, which are supplied from the principal ones, and 15 street boxes of the Brush patent type, containing transformers of 15 to 30 KW.

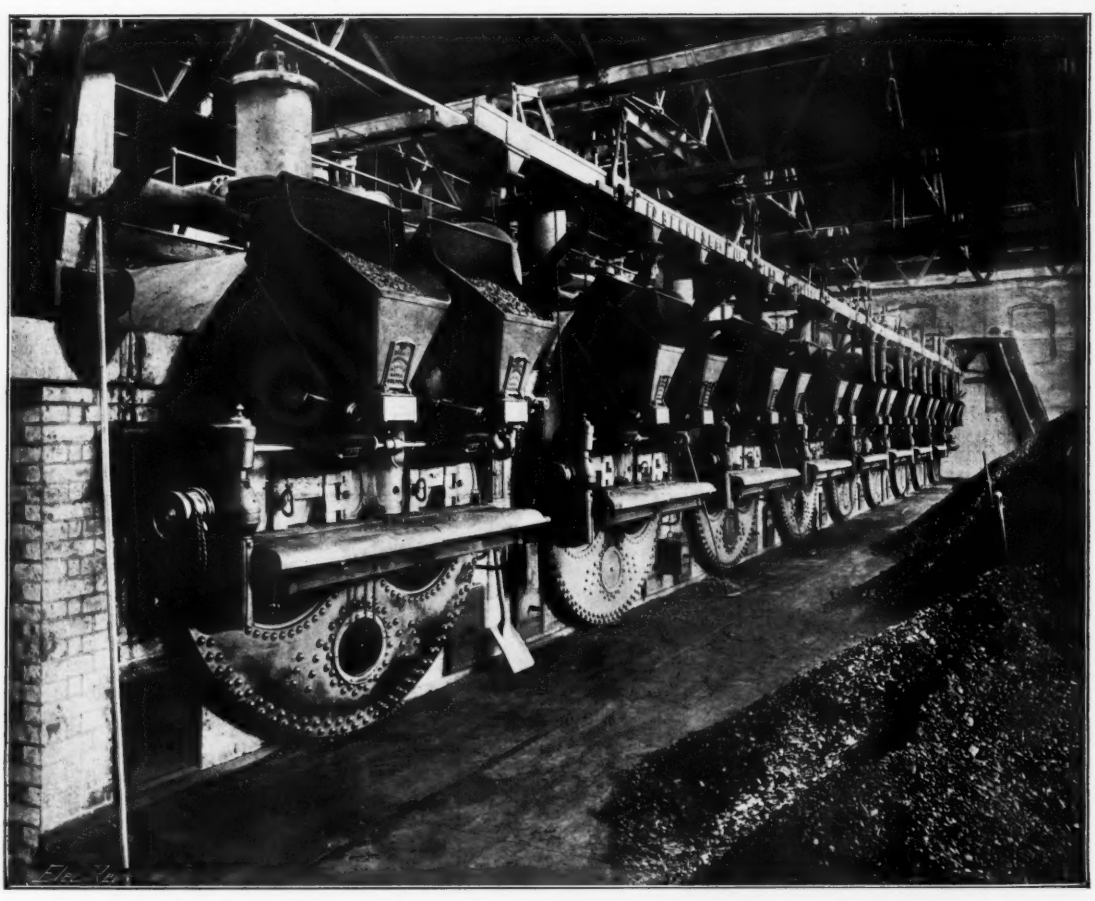
The whole of the cables were made by the British Insulated Wire Company, and are concentric, lead-covered and armoured. Both high and low pressure mains are laid direct in the ground in the same trench; to distinguish them, a copper wire is laid up with the armour of the high pressure cables. The main feeders to Stratford are 0·15 square inch, and to Canning Town 0·047 square inch. The low pressure distributors are mostly 0·15 square inch, the largest being 0·2 square inch.

For public lighting there are at present 88 arcs of the Thomson-Houston enclosed type, supplied by Messrs. Drake and Gorham, run in parallel across the high pressure mains, with a transformer in each post reducing the pressure from 2,000 to 83 volts. The number is to be increased by 100 lamps.

The low pressure supply is carried out on the two-wire system at 100 volts.

The charges for lighting are based on the Wright system, and are as follows:—For lighting, 7d. per unit for the first hour, and 3d. afterwards; for power, 5d. per unit for the first hour and 2d. afterwards. Thomson-Houston and Chamberlain & Hookham meters are used to measure the supply.

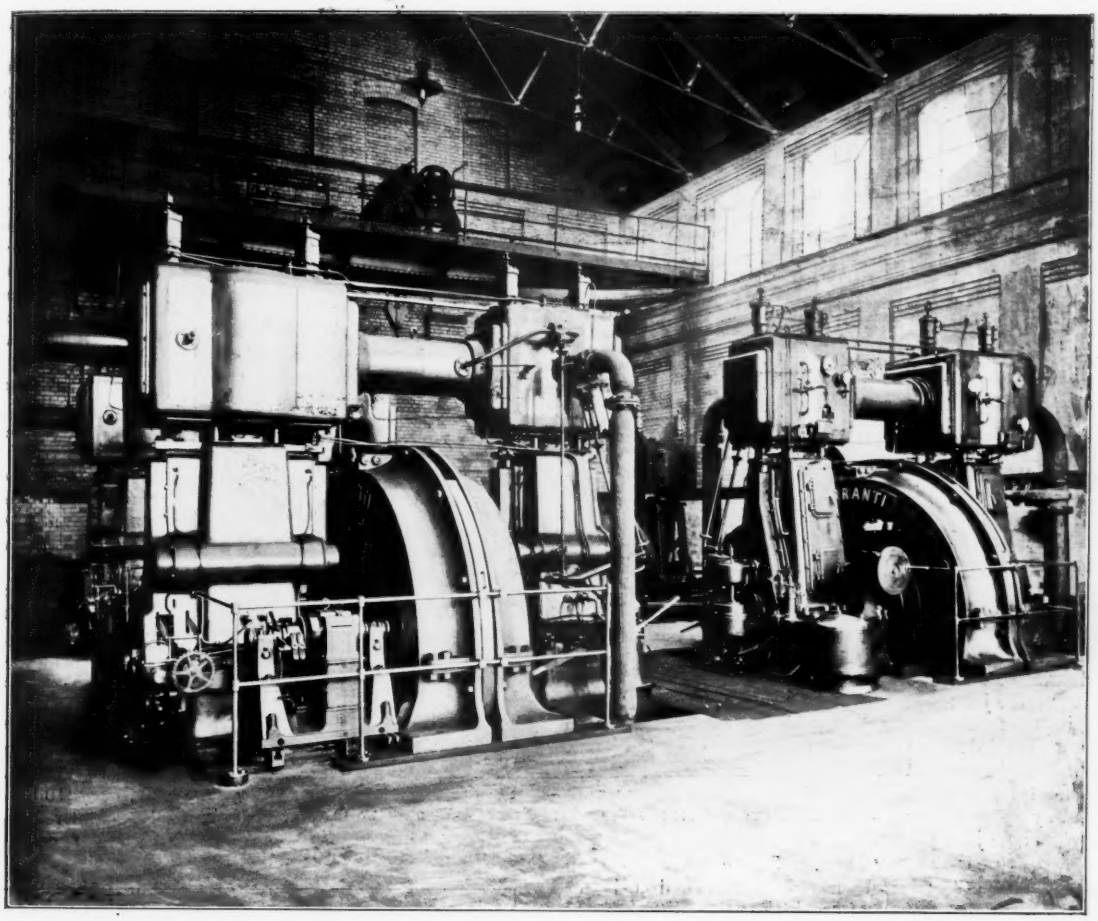
It seems to us to be a matter for regret that no attempt was made, so far as we are aware, to work the Corporation pumping machinery in conjunction with the electricity supply. It is commonplace nowadays to dwell on the advantages of a steady load; nevertheless, we rarely see a scheme laid out with a view to profiting by those advantages. Electricity supply for lighting purposes gives a daily load curve showing an extremely wide variation, which cannot be controlled. Pumping, however, is under the direct control of the engineers in charge, and by the addition of a reservoir it should be possible to regulate the load, so as to obtain, with the electricity load, a practically constant output. In the present instance the two departments are supplied, indeed, by the same boilers, but there is no provision to prevent overlapping of the loads. Single-phase synchronous motors to drive the pumps would have given perfect satisfaction, being under the direct supervision of the engineers; but, for that matter, there would have been no difficulty in the way of using two-phase alternators and motors, with benefit not only to the works, but to the power consumers also. There *may* have been insuperable difficulties in the way of such a scheme in this case, but we doubt it. As a case in point, we may cite the Bedford electricity works, where very similar conditions were met with; the sewage pumps are driven by alternate current motors, with the result that a considerable day load has been obtained.



West Ham.—Range of Lancashire Boilers.

In conclusion, we tender our thanks to Mr. Steinitz, who, we may add, has recently accepted the post of engineer to the Electrical Power Distributing Company; to Mr. J. K. Bock, the present borough electrical engineer, and the various contractors, for their assistance in the preparation of this article.

The British Association.—Wireless telegraphy will naturally be much in evidence at Dover during the meeting of the British Association. It is stated that, previous to his departure for America, Mr. Marconi will make all necessary arrangements for the demonstrations, which will be under the control of Prof. J. A. Fleming.

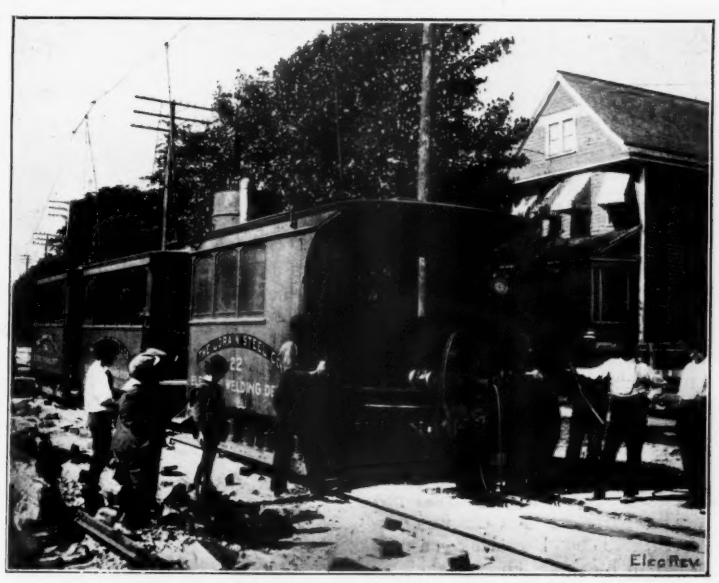


West Ham—View of Steam Alternators.

ELECTRIC WELDING TRAM-RAIL JOINTS.

[from our niagara falls correspondent.]

The Lorain Steel Company, of Lorain, Ohio, have one of their welding plants in operation in the city of Buffalo, where this year about 50 miles of track of the International Traction Company is to be welded. Of this length of track fully 25 miles will be of 60 feet 9 inches rails, with the ends left blank for the style of joint adopted. The Lorain Steel Company has succeeded to the business of the Johnson Company, and at present it has three plants in operation in as many cities in the United States. The process of rail welding has, it is felt, been perfected after years of experiment, and the results that are obtained are seemingly all that can be desired. As to the cost, it may be said that for the popular 9-inch girder rails, now so universally used, it is less than for any other style of so-called welded joint, while as a bond it is said to be the solution of the problem of electrolysis. In Buffalo the bar that is used for welding is 1 × 3 × 18 inches, and this joining of steel to steel, and the increased carrying capacity owing to the bars at the joints, results in the joint being the place of least resistance. The claim is made that a track electrically welded is of lower resistance than a rail itself.

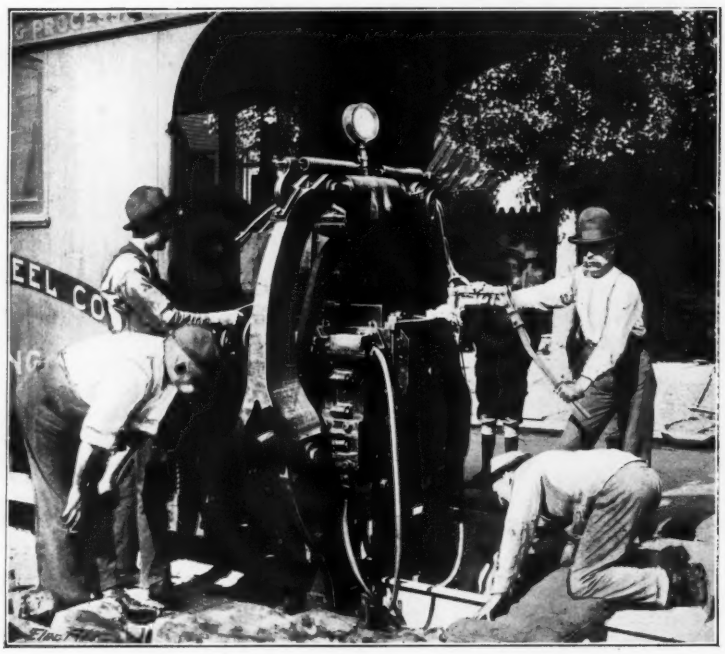


Electric Welding Tram-Rail Joints.—Machinery Cars.

The plant in operation in Buffalo consists of five cars. One of these is the sand blast car which runs in advance of the welding car, and prepares the joint. The other cars are the welding car, the transformer car, the motor and booster car, and a car that follows in the rear to smooth any rough places about the joint. In the adjoining illustration a train of three cars is shown, and these are moved along by power taken from the trolley service. The first car carries the welding apparatus, the car following has a transformer, and the rear car carries the booster and motor. The booster car weighs 34,000 lbs. A voltage of 500 is necessary for the

rotary transformer and apparatus. About 15 minutes are required to weld a joint, but the current is not in use all this time. In Buffalo the work of welding progressed night and day, there being no disturbance to residents of the street.

In streets where new track is laid the welding can be done before the pavement has been put down, or on old tracks, openings 17 by about 21 inches can be made in the pavement about the joint so that the welder can work. In other cases the pavement may be laid and openings of this size left until the welding machine has been applied. While at work the train attracts much attention, its operation and the results obtained being remarkable. After the welding bars are placed over the joint the jaws of the welder are applied to them, and a pressure of about 1,400 lbs. applied by means of a hydraulic jack connected to the upper end. The current is then turned on, and the metal heats brighter and brighter until the weld is completed, after which the current is turned off and the pressure increased to about 35 tons. While under this pressure the weld is allowed to cool, after which the car is moved back about 6 inches and the jaws applied to the other end of the bar, where the process is repeated. The other end is treated in the same manner. In other words the centre weld is made first and then the end welds. Artificial means of cooling are used, and as the bars cool they exert a powerful influence in bringing the rail ends close, so as to make a tight joint.



Electric Welding Tram-rail Joints.—Welder in Place.

The current for the operation of the plant is taken from the regular trolley wire service, and its application is well portrayed in the diagram given below. The current comes down

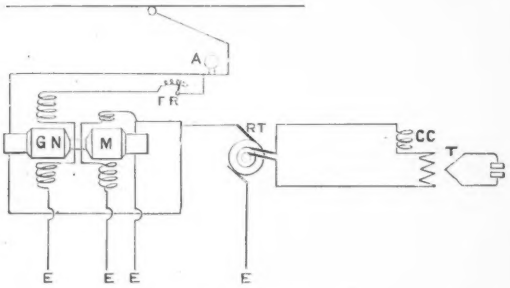
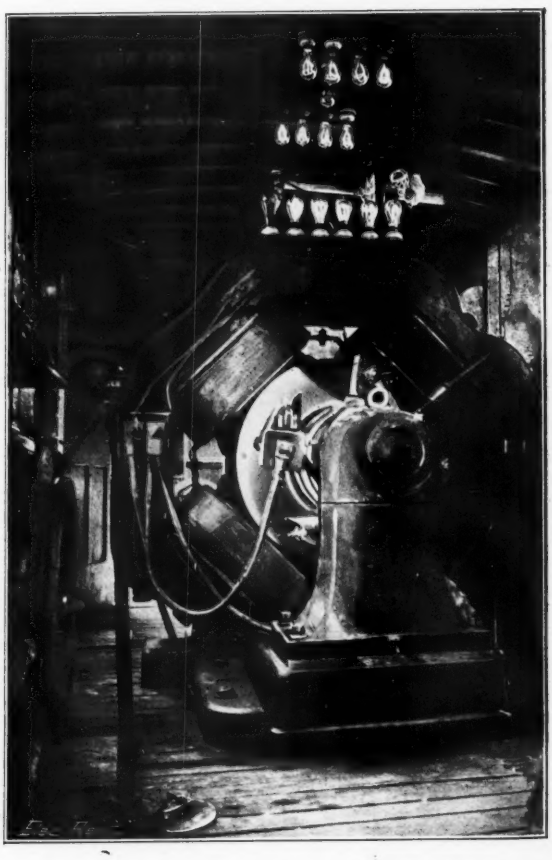


Diagram of Connections.

the trolley through the ammeter, A, and thence through a circuit breaker, which is not shown. It passes through the armature, G N, of generator end of booster, and then by one path through the armature and field of motor end of booster to earth. By the other path the current passes through the rotary transformer to earth. The alternating current from the rotary is led through a break switch and choking coil C, C, to the stationary transformer, T, between the welder jaws, the secondary of which consists, as shown, of one turn of copper. The terminals of the secondary are the clamps that grip the weld. In the diagram, F R represents a rheostat in the field circuit of the generator end of booster, by means of which it can be made to boost any amount desired to compensate for drop in the line voltage.

In reviewing this process one is naturally led to ask if heat will cause the rail to buckle, or cold cause the rail or weld to snap, but all these difficulties are overcome by the simple expedient of applying the immense pressure to the material during welding, therefore the length of a continuous rail made by this process is said to have no limit except that of the line itself. In summer, whatever expansion of the rail takes place is said to occur in the size, an effect not visible to the eye, but which, it is said, can be detected by careful measurements. In support of this claim as to the effect of cold in contracting the rails, it is said that given a continuous rail 10 miles long and one 100 yards long, under an equal degree of cold and surrounded by the same paving, the contraction at the ends of the rails will be practically the same in inches.



Electric Welding Tram-rail Joints.—Generator.

By way of explanation it may be stated that the bars with which the welds are made have three bosses, this having been found preferable to a flat bar. Thus the boss is the only portion that comes in contact with the rail, and all the heat is concentrated at that point. It has been stated that artificial means are provided for cooling while under pressure, and at this time the comparatively colder portions of the bar about the boss serve to prevent the softer metal from spreading. As the pressure confines it there is practically no opportunity for coarse crystallization, and the effect obtained is identical with that of hammering the steel.

The Lorain Steel Company gives due credit to Mr. A. J. Moxham for the perseverance that has led to the triumph and success of the welding process.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 315.)

Dingwall.—At the last Council meeting it was stated that with reference to the electric lighting of the burgh, the Council had signed an arrangement with Mr. Yorke, electrical engineer, binding the Council for 12 months not to entertain any other scheme. The 12 months were now up, and he asked what was to be done. The delay was caused by the fact that the Countess of Cromartie, not having attained her majority, was not in a position to grant water to them in perpetuity. The Countess being now of age, the Council could get on with the scheme.

Dumfries.—The Provisional Order Bill has received the Royal assent, and the Town Council is now in a position to proceed with the installation. Copies of the Act are being prepared for the use of councillors.

Eastbourne.—The electric lighting works are to be taken over by the Corporation on January 1st, and a resident engineer appointed at a salary of £300 a year. He will be required to devote the whole of his time to the duties of his office. Applications are to be sent in by September 1st.

Elland.—The District Council has appointed a committee to take steps to procure a provisional order for electric lighting.

Felixstowe.—The Felixstowe and Walton District Council has resolved to obtain a provisional order for electricity supply.

Fremantle (W.A.).—The harbour has been lighted with arc lamps.

Glasgow.—At the meeting of the Council last week Bailie Maclay, in moving the adoption of the accounts of the electricity department, said it would be seen from the figures that at the end of last financial year, after providing sinking fund, writing off liberally for depreciation, and after paying interest on capital account, they had a balance on the right side of £1,940. He thought this was satisfactory, especially as they had passed through a very trying year. They had spent largely on capital account, and that capital had been to a large extent unproductive. They had spent £100,000 in laying down cables in the streets of the city. These were still unproductive, but they thought it better to go on with the work vigorously, so that when the new plant was in working order there should be no delay in consequence of there not being cables to carry the electric current. He was happy to say that during the past year the output of electric current had increased 36 per cent., the number of consumers 30 per cent., the number of 8-C.P. lamps by something like 17 per cent. They had laid throughout the city 18 miles of new feeders and 28 miles of distributing mains. In regard to street lighting, in the previous year they had 119 street lamps; last year the number was 227, or nearly double. These lamps did not yield much, because they were only used towards the close of the winter. This year they would be used at the beginning of the winter. The original charge for street lamps was £26; some little time ago they reduced it to £18. Now they had reduced it to £14 which he believed to be the lowest charge for a street lamp in Great Britain. They had done this to encourage street lighting, and he was pleased to learn that the Watching and Lighting Committee had considered this question, and were prepared to go on with an extensive system of electric lighting of the streets of the city. Bailie Maclay further stated that the roofs were now on the new works at Port Dundas, that they had four new engines with dynamos coupled, and that they would be in full working order against the beginning of this winter. They were making great progress with the buildings on the south side of the river, and they had a large amount of plant on order both for Port Dundas and also for Pollokshaws Road station.—Mr. D. M. Stevenson said the interest on loans amounted to over £7,000, and of that £3,000 was on unproductive capital expenditure. He trusted that the Council would support him in getting a clause put into the next Omnibus Bill to be promoted in Parliament to place the interest on unproductive works to the capital account.—The accounts were approved.

Godalming.—The proposal of the Council to transfer its provisional order to the Urban Electric Supply Company, Limited, is recorded in the *London Gazette* for August 18th.

Heckmondwike.—The District Council has agreed to apply for sanction to borrow £14,000 for electric lighting purposes.

India.—The Indo-European Telegraph Company's offices at Kurrachee are to be lighted by electricity, an 8 H.P. Hornsby-Ackroyd oil engine and dynamo being installed for the purpose.

London.—Paddington Chapel, which is under reconstruction, is being lighted throughout by electricity and ventilated by means of motor fans. The contract has been entrusted to Messrs. Palmer & Watson, of Charing Cross Road, W.C.

The electric light has superseded gas at the Foundling Hospital, Guildford Street, in all parts of the building, including the chapel.

Lynn.—The electricity works is now almost complete, and the theatre supply has already been begun, as well as that of the Town Hall.

Montrose.—The Town Council has given its sanction to the contract between the Angus Electric Light Company, Limited, and Messrs. Edmundson's Electricity Corporation, Limited; the capital to be expended amounts to £15,000, which, in the opinion of Mr. W. Lackie, the Council's electrical adviser, is fair and reasonable.

Newbury.—We think that the Board of Trade's attention should be called to the recent decision of the Newbury Council not to proceed with a municipal lighting plant, yet to refuse the sale of the provisional order to the Electrical Power Distribution Company, to English Industrials, Limited, or to any other company that may express willingness to take the matter up. Furthermore, any application which may be made for a license or provisional order will be opposed. We have no doubt that at the proper time these companies or others will ensure an alteration in this state of affairs being brought about. During the past few weeks the Board of Trade has issued several notices of revocation of orders, and where, as at Newbury, a municipal authority has distinctly stated that it will not carry out the work itself, there seems to be no reason why an order obtained in 1892 for the execution of certain powers within two years should be in existence any longer. Revocation seems to be urgently called for at Newbury. Under the Board's extension grant the order expires within the next six months, but even that seems to us a needless delay after the matter has been shelved so long.

Paisley.—Although the electric lighting scheme for the burgh is not yet completed, so many orders for the new light have been received that the Electric Lighting Committee has asked the Town Council for powers to extend the machinery already placed in the works at Blackhill.

Penarth.—The District Council has yielded to the request of the Electrical Power Distribution Company for an extension of the time before purchase, and has increased the limit from 15 to 38 years.

Penzance.—The Town Council has decided to proceed with the application for a provisional order under the Electric Lighting Acts. The borough surveyor, Mr. Latham, suggests that the losses of the first three years, estimated at £4,150, should be provided for in the loan to be raised, and made part of the capital cost of the undertaking. In eight years he anticipates that the demand will reach 200,000 KW.-hours, and that there will be a profit of £1,000 at least on the working.

Pontefract.—The Guardians have been advertising for an electrical engineer to advise *re* an electric lighting scheme for the Union Workhouse and premises.

Portsmouth.—Last week, in connection with their summer excursion here, a party of the Institution of Junior Engineers visited the Corporation electricity works, and was shown round by Mr. Price, the superintendent.

Sheldon.—The District Council has resolved that Messrs. Hancock & Dykes be employed to make a survey of the district, and report on its suitability for the purpose of electric lighting, this firm having offered to send an expert for the sum of £25.

Walker.—Application has been made to the Estate and Property Committee of the Newcastle Corporation by the Walker authorities for the erection of a power station to generate electricity.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barcelona.—The directors of the Barcelona Tramways Company, Limited, report for the year ended December 31st that the receipts for 12 months were £62,255, against £73,043. The gross profit on working was £8,081, against £12,064. The falling off in traffic receipts was due to a variety of causes, chief among which were the interruption to traffic occasioned by the change of traction, the depression caused by the late war, and the stoppage of streets by the extensive system of municipal drainage works. The increase in traffic receipts to date in 1899 has already covered the total decrease of the year 1898, although the electric traction has only gradually come into working and has still to be extended to a small portion of the system.

Blackpool.—A serious accident happened on the Blackpool and Fleetwood tramroad in Warbrick Road, Blackpool, on Saturday afternoon last. A milkman named Swift was driving a horse and float, and got into the lines. A tram came up, and before it could be stopped it smashed the milk cart to pieces. Swift was pitched out, and the wheels of the tram passed over his left arm. He was taken to the hospital, where the arm had to be amputated; he had previously lost the other. He had a serious scalp wound, and was then in a critical condition.

Bradford.—Complaints having been made as to the delay caused by the electric cars stopping at Southfield Lane, on the Great Horton section of the tramways, we learn from the *Bradford Observer* that this is unavoidable, because of the restrictions as to speed imposed by the Board of Trade since the unfortunate accident which took place there. It appears that by order of the Board, 35 minutes must be occupied in the down journey of 2¾ miles, and, however the drivers may check the speed, it is hardly possible to go slowly enough to avoid getting there too soon! Hence the wait, for the express purpose of losing time to comply with the order. We have heard of coaches being driven through Acts of Parliament; here is a tramcar standing still through a Board of Trade regulation! It is unnecessary to point out the absurdity of the order, which, however well-meant, is absolutely ineffective in limiting the actual speed at any moment.

It is now practically decided that communication shall be set up between the Leeds and Bradford tramway systems by means of a light railway from Thornbury to Stanningley, the total length being two miles. The line will be worked with steam by the Bradford Tramways and Omnibus Company until the expiration of the leases in January, 1903. The Leeds Corporation will probably extend one of its lines to meet the new line at Stanningley.

California.—A short description is given in the *Mechanical World* of a power transmission scheme which has been carried out at Mount Whitney, California. Water-power to the extent of 1,800 H.P. is obtained from the Kaweah River, whence the water is carried in a flume six miles long and a pipe line 3,300 feet long to the generating station. Electric power is generated and transmitted at 17,000 volts, three-phase, to Visalia, 29 miles away, and at 34,000 volts to Tulare and Porterville, 40 miles away. It is used chiefly for irrigation and lighting.

Dewsbury.—The Councils of the Spen Valley are troubled about the decision of the Light Railway Commissioners in favour of the British Electric Traction Company, and are discussing ways and means of reversing it. Some stress will probably be laid on a clause in the Dewsbury Improvement Act, 1884, giving the Corporation the right to refuse permission to place electrical apparatus along the streets of the borough. This clause, however, if the Board of Trade confirms the decision of the Commissioners, will *ipso facto* be repealed, and confirmed it will be, unless the five authorities concerned bury their differences and unite in opposition to the measure.

Driffield.—The District Council has been approached by the Drake & Gorham Electric Power and Traction Company, Limited, with a view to the construction of a light railway between Driffield and Beeford. A line has already been sanctioned from Beeford to Beverley, and it is said that the North-Eastern Railway has taken over the project.

Dublin.—The southern district of the Dublin United Tramways Company, which is operated entirely by electricity, shows for the first half of 1899 an increased net profit of £4,600. the gross revenue increased 50 per cent. in the past year, and the net revenue rose from £6,200 to £16,200. Evidently the benefits of electric traction are not confined to the passengers—the shareholders also have reason to congratulate themselves. The Tramways Committee of the Corporation, however, in view of the unfortunate accidents which have occurred lately, has requested the company to instal a third man on each car to look after the trolley pole. We should anticipate a very different balance-sheet if this extraordinary request were complied with. There are more rational ways of dealing with the matter—detachable trolley heads, for instance.

Another accident has occurred due to the trolley jumping the trolley wire; the guard wire was broken, and a carman named J. Caffrey was struck by one of the falling ends and rather seriously injured.

Last week the Tramway Company made some trial journeys to Terenure and back with a number of electric tramcars. Special interest attached to this trip, as these cars were the first worked by the new power station at Ringsend, which is to take over the working of all the electric traction in Dublin. The trials were in every way satisfactory.

Eccles.—A conference is shortly to be held at Eccles between representatives of the various local authorities, to consider the project of the United Kingdom Electrical Tramway and Light Railway Syndicate, Limited, for light railways in the district.

Factory Driving.—Messrs. Waterlow & Layton's new factory in Clerkenwell has been equipped with a system of electrical power transmission by Messrs. Crampton & Co., of Norwich and Cambridge. The generating plant consists of a 50-H.P. gas engine and dynamo, which supplies both the lamps and the motors. Each machine is provided with a separate motor.

Greenock.—The Law and Finance Committee has decided to recommend the Police Board to make arrangements for leasing the burgh tramways as an electrical tramway, and that the Committee be instructed to draw up conditions upon which offers will be received.

Goods Traffic.—The Isle of Man Tramways Company has commenced a service of "Bonner" rail wagons, which can be drawn by horses on ordinary roads to collect goods, and are afterwards mounted on bogies running on the tramway lines for transport. In this way the goods are transmitted the whole distance without being re-handled.

Grimsby.—The Lighting and Tramways Committee has come to terms with the Grimsby Street Tramways Company for the renewal of road leases; various improvements are to be carried out, and electric power is to be supplied by the Corporation, which has the option of purchase at the end of 10 years.

Halifax.—The Tramways Committee has under consideration the choice of routes to Brighouse and other districts to which the tramway system is to be extended.

Hastings.—A mass meeting and procession is to be held early next month in support of the tramway movement at Hastings.

Huddersfield.—The City Borough Council of Huddersfield on August 16th appointed Mr. J. Williams to be charge-engineer at the electric supply station, and Mr. W. E. Warrilow to be electrician-in-charge.

The Tramways Committee have decided to extend their system of tramways (which will in part be converted to the electric trolley system) to Llaithwaite and Marsden and to Brighouse and Bailiff Bridge.

The borough accountant reported the cost of the various works in connection with the adoption of electric traction to be:—(*a*) Power station, £8,000; (*b*) equipment of power station with boilers, machinery, &c., £17,120; (*c*) equipment of Outlane section with cables, poles, &c., £5,374 2s. 4d.; (*d*) equipment of Marsden Road section, £2,331; (*e*) equipment of Longroyd Road section, £3,457; (*f*) electric cars, £11,500; total, £47,782 2s. 4d. This is the portion of the whole system to be carried out forthwith. The work is already commenced, and the construction is expected to occupy two years. The estimated life of the works is (*a*) 30 years, (*b*, *c*, *d*, *e*) 20 years, and (*f*) 15 years.

Italy.—An electric tramway has been completed and put in operation in the town of Como. The line, which is only about a mile long, has been constructed by the Helios Company, of Ehrenfeld, Germany, and will be extended later.

Kelso.—Proposals are on foot for the utilisation of the water-power of the Kelso flour mills for working tramways, electric lighting, and pumping the town's supply of water. At present, about 100 H.P. is available from the turbines.

"Let Glasgow Flourish!"—A deputation of gentlemen from Copenhagen visited Glasgow last week, for the purpose of inspecting the tramways and electric lighting of the city. This is rather a novelty—we are more accustomed to seeing *our* deputations cross the ocean, than to receive visits from abroad. Things are looking up!

Liverpool.—An exchange says that a start has now been made with the proposed electric tramways from Seaforth to Crosby. It is anticipated that the line will be completed before next Easter.

Mytholmroyd.—The District Council is endeavouring to induce the Halifax Town Council to include a branch line down Cragg Vale in the projected extensions of the electric tramways.

Newcastle.—On August 18th the Tramway Committee of the Corporation had before it the question of adopting some form of conduit or surface contact system in the centre of the city in connection with the general overhead or trolley system outside. After a long discussion it was agreed that the Council be recommended to apply the trolley system throughout, as in the opinion of the committee it would not be wise, in the present state of uncertainty as to the suitability of the conduit system, to lay down any system of the kind.

Oldham.—The town clerk reported to the Surveyor's and Tramways Committee on August 17th that the Tramway Bill had become an Act of Parliament, receiving the Royal assent on August 8th. The Tramways Committee intends to ask the Electric Light Committee to supply the power for the tramcars. It was decided that the resolution passed some time ago, adopting the trolley system, be presented to the next meeting of the Council. A complaint was made that power had not been obtained in the Bill, which has just received the Royal assent, to increase the number of double lines in the borough. It appears that when the measure was under consideration, it was authoritatively stated that they could not come nearer the footpath than 9 feet 6 inches from the outer rail, but members of the Committee have since observed in Leeds tramrails within a yard of the kerbstones. The only way to get over the difficulty now is by another Bill, which is a somewhat expensive proceeding.

Portsmouth.—Mr. A. Bannister, whose appointment as tramway engineer was recently recorded in our Traction Notes, has withdrawn his application, his present employers having made it to his advantage to remain at Norwich. The Tramways Committee has therefore recommended Mr. Rotter's application for acceptance, and the Council has approved of his appointment.

Printing Press Equipment.—According to the *Newspaper Owner*, the proprietors of the *Scotsman* have contracted with the Bullock Electric Company, Cincinnati, through their London agents, Messrs. Bergtheil & Young, for a complete equipment of electric motors for driving the new quadruple and four-reel presses which are now being built for them by Messrs. R. Hoe & Co., of

London and New York. The motors are of 50 H.P. each, and are interchangeable in all parts. This installation is part of the complete newspaper plant about to be placed in the new *Scotsman* offices now in course of erection in Edinburgh.

Rawdon.—At a meeting of the Joint Tramway Committee of the Horsforth, Rawdon and Yeadon District Councils, held at Rawdon last week, it was stated that, contrary to its original purpose, the Leeds Corporation was willing to extend the city tramways as far as Yeadon. The Horsforth members objected to the Leeds Corporation having anything to do with the scheme. The Joint Committee will confer with the committee of the Corporation on the subject.

Southend.—The Town Council has appointed a committee to carry out the Light Railways order. The question of electric lighting is to be considered in conjunction with that of traction.

Tees-side.—The returns for last week show that the Middlesbrough, Stockton and Thornaby electric tramways carried 275,000 people between the three towns; this enormous traffic was dealt with without a single accident, although 50 cars were running with a three-minute headway. The necessity of doubling the line between Middlesbrough and Thornaby has been clearly proved. Mr. Clifton Robinson himself took an active part in directing the traffic, and on one occasion was instrumental in preventing a serious collision.

Tunstall.—The District Council will oppose the application of the Potteries Extension Tramways Company for an extension of time to October 1st next for the completion of their lines so far as the application regards the sections from the Council's boundary in Scotia Road to the terminus at Goldenhill.

TELEGRAPH AND TELEPHONE NOTES.

Cable Communication with the West Indies.—As the Halifax and Bermudas and the Direct West India Cable Companies' cables terminate at Jamaica, the recent interruption of the connecting companies' cables between that island and Puertorico prevented the acceptance of messages for the West India islands east of Jamaica at the usual rates. The Halifax and Bermudas Company announces, however, that it has been advised by the West India and Panama Company of the repair of the broken cables, and that messages to the West Indies may be sent "*viâ* Bermuda," as before, at the usual charges.

Interruption of Australian Trunk Landline.—According to the *Sydney Morning Herald*, of 13th ult., "At half-past 3 o'clock this morning we received word from the Electric Telegraph Department that the overland line to Port Darwin was interrupted north of Powell's Creek. We are consequently without our cricket cable news giving the result of the third day's play in the match at Edgbaston, Birmingham, between the Australians and the Midland Counties Eleven, in which the game is at an interesting stage."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	April 4th, 1898 ...	...
Bonny-Cameroon	May 29th, 1899 ...	August 21st, 1899
Latakia-Cyprus	June 20th, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Accra-Grand Bassam	August 1st, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Iquique-Valparaiso	August 15th, 1899 ..	...
Jamaica-Colon	June 30th, 1899 ...	...
Jamaica-Porto Rico (Ponce)	August 15th, 1899...	...
Jamaica-Porto Rico (San Juan)	August 15th, 1899...	August 22nd, 1899
Cape Haitien-Puerto Plata ...	August 21st, 1899...	...
Cape Haitien-Mole St. Nicolas	August 21st, 1899...	...
Cable communication with West Indies except—Jamaica, Cuba, and Haiti Republic.	August 21st, 1899 ...	August 22nd, 1899
Cable communication with United States of Columbia, except Isthmus of Panama	August 17th, 1899 ...	August 21st, 1899
Nagasaki-Fusan	August 20th, 1899 ...	...
Serena-Valparaiso	August 18th, 1899 ..	...
Zanzibar-Mombassa ...	August 17th, 1899 ...	August 18th, 1899
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	...
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, and Cape Haitien Port au Prince to Miribalais and Jacmel	August 18th, 1899...	...

Natal Telephones.—The *British and South African Export Gazette* says that the estimates of the Natal Government for the year 1899-1900 include £2,700 for improvements in the telephone system, besides £4,480 for additional telephonic communication; £1,500 for the installation of electric light in Government buildings; and £1,120 for batteries, instruments and materials.

The Reduction of Rates to India.—We are glad to see that the leading journals in India are now interesting themselves in a movement, which we hope will prove to be of ultimate benefit, both to that empire and to this country. Although we have treated of this subject very frequently, and for several years, we cannot refrain from again calling attention to the heavy tax, by comparison so utterly inequitable, which is imposed on Indian commerce, and on those whose social relations with India, oblige them to telegraph, even at the present excessive rates. To be obliged to pay 4s. per word for a telegram between Bombay and London, is a serious matter; but this is all the more to be objected to when we know that a message in transit between England and Australia is carried for about 1s. 5d., over exactly the same distance (and entailing, if anything, less work), as that which costs 4s. per word to the persons who telegraph from India to England, or *vice versâ*. There is not the slightest doubt that the existing "joint-purse" system keeps the charge for telegrams to or from India at an exorbitant figure. We understand that the Indian Government purpose to make another attempt to procure a reduction; but stronger measures than banal protests at triennial conferences may be looked for. Although we do not see eye to eye with Mr. Henniker Heaton in his proposed methods of reforming this scandal, we cannot help being impressed by some of the arguments he advances in the following letter which appeared in the *Times* of last Tuesday:—

Osborne Villa, Carlsbad, Austria, August 19th, 1899.

Dear Lord George Hamilton,—The question of reducing the present high telegraph charges to India is, I know, engaging your attention. I beg that you will not come to any decision on the matter until you have heard Sir Edward Sassoon and myself. We take the ground that any subsidy given by the Indian Government will considerably hamper competition and block the way of really cheap telegraph rates to India, Australia, and the East for many years. I have shown in articles in the *Nineteenth Century* and in the *Times* that all that is necessary is to link up the present land lines in order to have sixpenny rates to India; I have pointed out that land lines can be constructed at a fourth of the cost and will carry five times more messages than cables; I have pointed out that to-day the cost of a telegram from St. Petersburg to Vladivostok, nearly 6,000 miles, is about 2½d. per word, whereas from London to India by land the charge is 4s. per word by the Indo-European Telegraph Company's lines; finally, I have indicated four different land routes to India where "linking up" can be effected. The only reply to these statements is that the Ameer of Afghanistan will not consent to our constructing a telegraph line into or through his territory. It appears incredible that the enlightened Ameer, who receives a very large sum of money every year, from England or India, in the shape of a subsidy, declines to allow us to construct a telegraph line. He is surely aware that a telegraph line will not steal even the air or injure him in any way. My information, however, is that the permission of the Ameer can be obtained. [A statement of mine (questioned by a correspondent of the *Times*) that the Ameer had allowed telegraph lines to be laid to Kandahar and Kabul is borne out by the enclosed map issued by the Eastern Telegraph Company, in which you will see such wires are duly marked.] At all events we (with your sanction) intend to make an effort through other agencies to get the Ameer's consent. Even if it cannot be obtained, there are three alternative lines open to us. You are aware that both the Eastern Telegraph Company, its joint purse partner the Indo-European Company, and the Imperial Telegraph Committee of the House of Commons recognise that it will take many millions of money to secure an entirely round the world all-British telegraph cable line. It was alleged by representatives of the first-named company that, as everything is disarranged in times of war, it is better to depend on fast cruisers than on cables, because it is impossible to patrol a cable 2,500 miles across the ocean. We send our English mails to India and Australia every week through two foreign countries, France and Italy; then why object to telegrams (98 years in 100 we are at peace) going through foreign countries? We are now struggling on behalf of the merchants, tenders, and social classes against a great monopoly—a monopoly condemned in the strongest terms by your colleagues. Our work will be seriously impeded and we shall be crippled for another generation if you give your sanction to a further subsidy to these cable companies.

I am your faithful servant,

J. Henniker Heaton.

Sydney Telephones.—Part of the telephone system of Sydney (N.S.W.) is being changed over to the metallic return method at a cost of about £30,000. This is a precautionary measure taken by the Post Office in view of the conversion of the tram system from steam to electrical working.

South African Telegraphs.—Dispatches from Cape Town to the daily press say that the Imperial telegraph line has been opened to Maseru, the capital of Basutoland.

The Telephone Service.—The Cardiff Chamber of Commerce is of opinion that the Government Telephones Bill "will be infinitely less satisfactory to the country than if arrangements had been made for placing the whole service under Post Office control." Cardiff delegates to the autumnal meeting of Associated Chambers at Belfast are to be asked to ascertain the feelings of other delegates on the matter, and to submit a resolution to the above effect if thought desirable.

The Postmaster-General having asked whether the Council proposes to renew its application for a licence to transact telephone exchange business, the Council has instructed the town clerk to make the necessary application.

Wireless Telegraphy.—A *Times* telegram from Odessa says that trials of Signor Marconi's wireless telegraphy will shortly be made between Sevastopol, Nikolaieff, and the Black Sea fleet.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barnsley.—September 16th. Tenders are wanted for electric light wiring and fittings at the Harvey Institute, Eldon Street, for about 700 lights. See "Official Notices" August 18th.

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Battersea.—August 31st. The Vestry wants tenders for steam pipes, pumps, condensers, economiser, tools, &c.; also switchboard and booster. Specifications at the office of Prof. Kennedy, 17, Victoria Street, S.W. See "Official Notices" July 28th

Brighton.—August 30th. The Borough Council wants tenders for the installation of a system of telephonic intercommunication between the various offices of the Town Hall. Specification, &c., from the office of the borough engineer, Town Hall.

Carlisle.—September 11th. The Corporation wants tenders for extension to steam, drain, and feed pipes, feed pump, and extension of economiser at the electricity works. See "Official Notices" August 18th.

Devonport.—August 31st. The District Tramways Company invites tenders for the following contracts: Permanent way, road bed, paving and bonding of about 4½ miles of double line, overhead construction for about 4½ miles of route. See "Official Notices" August 11th.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" August 4th.

Germany.—September 20th. Tenders are being invited until September 20th by the Cotton Wool Exchange authorities in Bremen for a complete installation of electric lighting in the new Exchange. Tenders are to be sent to Das Banbureau für die Bremer Baumvoll börse la Dechanatstrasse, Bremen, whence particulars may be obtained.

Hackney.—September 12th. The Vestry wants tenders for four sets of direct current steam dynamos (either high or low speed). See "Official Notices" August 11th.

Heckmondwike.—September 20th. The District Council wants tenders for the supply of water-tube boilers, economiser, pipe work, steam dynamos and motor boosters, accumulators, switchboard work, travelling crane, mains, arc lamps and posts, and station lighting. See "Official Notices" this week.

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices" August 18th.

Ingleton.—The Ingleton Electric Light and Power Company wants tenders for the supply of dynamos, switchboards, batteries, and wiring. See "Official Notices" August 4th.

Leeds.—August 30th. The Tramways Committee wants tenders for the electric lighting of the car sheds, Kirkstall Road. See "Official Notices" August 18th.

Luton.—September 22nd. The Council wants tenders for boilers, superheaters, engines, dynamos, switchboard, steam and other piping, batteries, street conduits, boxes, feeders, arc lamps and posts, and various other plant and machinery for the electric lighting installation. See "Official Notices" this week.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Moscow.—*Commercial Intelligence* says that next month electrical engineers and contractors will be invited to compete for the electric railway for Moscow. The contract will probably require an expenditure of about 20,000,000 roubles.

Perth.—August 28th. The Commissioners want tenders for boilers, condensers, steam dynamos, switchboard, underground mains, and accessories. See "Official Notices" July 28th.

Poplar.—September 6th. The Guardians want tenders for high speed engine and dynamo, electric motors, Lancashire boilers, economiser, and other plant, as briefly particularised in our "Official Notices" August 18th. Mr. Warden-Stevens, the consulting engineer, asks us to notify that Section L., Steam Jet Plant, relates to ejector condensers, jet pumps, and injectors; and Section M., Auxiliary Pumping Plant, to air compressors, centrifugal pumps, and three-throw pumps.

Portugal.—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

St. Annes-on-the-Sea.—September 11th. The Council wants tenders for high speed engines, continuous current dynamos, and balancing booster, for electric lighting. See "Official Notices" August 18th.

Southport.—The Corporation wants tenders for the supply and laying of tram rails, points, crossings, bonding, permanent way; also overhead equipment, including poles, wires, &c. See "Official Notices" August 11th.

Sunderland.—The Corporation wants tenders for four 270-kw. three-crank direct current steam dynamos, and two surface condensers and cooling tower. See "Official Notices" August 18th.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

CLOSED.

Belfast.—Messrs. Wimshurst, Hollick & Co., are to convert a 2-ton jib crane from steam to electric power for the Belfast Harbour Commissioners.

Brighouse.—The Council has given a contract (£329) to Mr. T. H. Churton, of Leeds, for electric lighting plant for the sewage disposal works at Cooper Bridge.

Glasgow.—In addition to the recommendation that the contract for main engines be given to Messrs. Allis, the Tramways Committee also recommended that the following tenders should be accepted, the whole sum involved, including that of the main engines, being £253,653 13s.:—

	£	s.
Auxiliary engines—E. P. Allis Company	8,375	7
Exciter engines—W. H. Allen, Son & Co.	3,054	0
Boilers—Babcock & Wilcox Company, Limited	21,280	0
Three-phase generators—British Thomson-Houston Company, Limited	25,670	0
Auxiliary generators—British Thomson-Houston Company, Limited	5,343	10
Exciter generators—British Thomson-Houston Company, Limited, London	1,711	0
Transformers—Westinghouse Electric Company, Limited, London	34,420	0
Rotary converters and boosters—Westinghouse Electric Company, Limited, London	39,215	16

Grimsby.—The Corporation Special Committee last week considered the tenders for the supply of machinery and plant for the electric lighting scheme. Seven tenders were sent in for the boilers, and that of Messrs. Anderton & Co., of Accrington, was accepted. Nine tenders were submitted for the engines and dynamos, Messrs. Mather & Platt being successful. The Tudor Accumulator Company obtained the contract for the batteries in competition with six other firms, and Messrs. Jas. White, Limited, were selected to supply the switchboards. The contract for the mains was secured by the British Insulated Wire Company. No tender was accepted for the supply of arc lamps, as Prof. Kennedy wished to test a certain make before advising the Corporation. The amount of the tenders is stated to exceed the original estimates. The explanation given for this is that the plans have been extended, and that the prices of materials have gone up 15 or 20 per cent. since the estimate was made.

Harrogate.—The Town Council has resolved to order the following plant:—A 600-H.P. engine with necessary pipes, &c., from Messrs. Maclaren, at £2,398; a 300-kw. alternator from Messrs. Ferranti, at £1,700 (less £215 for dayload plant returned); an ejector condenser from Messrs. Korting Brothers, at £550; an additional trunk main from the British Insulated Wire Company, for laying from the central station to the high pressure distributing centre. The surveyor is to prepare plans, &c., for the necessary buildings extensions for the above.

NOTES.

An Interesting Question.—The following query comes to hand as we go to press:—"Gentlemen,—I should be very much obliged if any of your readers will inform me why it is that alternating current motors spark so much more than do continuous current motors.—A. P."—[They don't.—EDS. ELEC. REV.]

The Renewable Lamp.—We are afraid we cannot congratulate the Renewable Lamp Company upon the line of action adopted by its advocates. We published a letter the week before last from "Charles Clifford," purporting to give us enlightenment regarding the lamp. In the usual way we placed our columns at Mr. Clifford's disposal, he having expressed a wish to go further into details. So far, no letter signed by Mr. Clifford is to hand, but we have, instead, received one giving an entirely different name and address, and signed "Lancastarian" (*sic*). The spelling of Mr. Clifford's letter was edited by us before publication, but in order that our readers may see for themselves how strikingly the errors of the two communications are in agreement, we print them both in parallel columns, the errors in each case being shown up distinctly. There is strong evidence of an attempt to disguise the handwriting, but the similarity is so palpable as not to require an expert to detect it. We think it will be clear that the writer of the two letters is the

same. Curiously, in one letter he is a "friend of the patentees," and in the other he assumes the *rôle* of "an impartial observer."

Re the Patent Renewable Glow Lamp.

Anent your remarks on above in last weeks issue of your enterprising journal, will you permit an old reader, and a friend of the patentees, & one cognisant of the incomparable advantages of which the above lamp is alone capable, to clear the ground of certain misapprehensions in this relation? First let me say that, had I space & your permission, to give in detail the unique capacity of this lamp to prolong its utility, at such a small outlay of material, time, labour, & money, & to explain how through the continuous interchangability of its filaments the thorough utilisation of all its material is effected to the utmost extent, the commercial value & complete public service claimed for this innovation by those of the highest repute & honour as practical experts who have submitted it to the most crucial tests, would be so manifest that, even your hypercritical correspondent *"Experimenta Docet"* would admit the justice of the claim that this lamp will not only be the salvation of the enclosed globe, but supplies the longfelt public want among consumers of the current, by revolutionising the present system of lamp replacements, & doing away with the practice of having new lamps, & paying full prices for same.

And so far from *efficency* being sacrificed for cheapness it will be found, by comparison, that it is the highest ever recorded so soon as the lamp is on the market.

Surely it must be a great commercial achievement in any industry to reduce maximum waste of material & labour, has instanced in the Glow Lamp Industry at present, where incomputable & broadcast waste of Glow Lamps takes place the moment the lamps at present in use, reach the end of their first, and only, life?

True, many have tried to solve the problem of interchangeability of filaments even Westinghouse with his glass stopper, &c., how impracticable these devices were doubtless you are aware sir, but none hit upon the simple design of a tubular neck & expeditious method of exchanging filaments devised by C. Howard.

Depend upon it, Sir, if the advantages claimed were not genuine & had not been actually demonstrated neither Sir W. H. Preece, nor Major Cardews names would have been on the front page of the prospectus to bear testimony to the same, neither would Mr. Jacob Atherton of The British Insulated Wire Co., a most successful Compy, been identified with it unless it was the inimitable lamp the inventor asserts it to be. The economy claimed will on comparison be found to be actual and enduring, & be assured that its come to stay, despite *"Experimenta Docet,"* whose friends will find shortly that their large stock of lamps &c. &c. are *obsolete* and unsaleable. Without attempting to answer his assertions let me say that, all his objections have no relation, or bearing, to the above lamp, & proves conclusively "how little" he knows of the invention. In conclusion, let me add that (1) the Compy only claim to renew their own lamps, it is impossible to renew any other, (2) The filaments are of that peculiar kind that the bulbs are free from deposited carbon, (3) The glass too is unique & manner of opening, & fusing, so practicable that breakages will be very rare. (4) The detachable socket as withstood the most severe tests & is a perfect success & will admit of being used perpetually. (5) In all other lamp factories there is a certain loss of between 25 & 30 % on lamps made, through some non-glowing defect, broken filaments &c., in the manufacture of this lamp such loss will be unknown, has the least, or most serious, defect can be at once rectified by opening at neck where renewal of filaments takes place. That the economising & prolonging utility of this lamp is without parallel in this Electrical age, goes without saying, & consumers will ere long have the *opportunity of verifieing.*

I could add to what I've said, but for fear of incurring your displeasure Mr. Editor. Thanking you in anticipation of your inserting this, & apologising for its length I remain faithfully yours

CHARLES CLIFFORD.

Re "The Renewable Lamp."

Dear Sir,—May I draw your attention to the fact that you made a favourable allusion to the above in your January number of 1897? As an impartial observer, I would endorse all your correspondent, Mr. C. Clifford, claims for the above, because the said claims are endorsed by gentlemen whose names are beyond reproach, and whose capacity to judge of this new lamps amplified utility, and peculiar *efficency* cannot be doubted.

That a renewable lamp is a most desirable agent, & would prove a most economical boon, to consumers must be admitted even by such detractors as *"Experimenta Docet,"* whose line of attack was most "Unenglish" to use the mildest term, especially in face of the support accorded this remarkable lamp by Sir W. H. Preece, Major Cardew, &c., &c.

I consider all credit and support is due to any inventor, who finally achieves what previous experts failded to accomplish, & it is the worst of form, and betokens a carping disposition to be in haste to damn anothers brainwork before understanding the essence, or basis, of the invention, and before the public have had an *opportunity of verifieing.* Possibly *"Experimenta Docet"* is in the lamp trade, and, as C. Clifford reminded him, is afraid of his stock becoming *obsolete.*

One fact is clear, present Glow Lamps are out of date, from their powerlessness to prolong their utility after their first filaments have burnt out; the majority of them lack *efficincy* & uniformity, and although they claim to burn 1,000 hours they only burn about half this period, and then throw off that "red glare" which is so distressing to us poor observing consumers, yet so profitable to the supply companies.

I for one shall range myself under the testimony of the above universally known experts, & accord this renewable glow lamp a fair trial when I can purchase them, & I assure you, Sir, I shall be one of your first correspondents to report my experiance. Hoping I have not transgressed,

I remain yours obediently,

LANCASTARIAN.

Electric Power at Niagara.—Prof. George Forbes has written the following interesting letter to the *Times*:—

Sir,—It was with unmixed pleasure that I have been able to pay a long-promised visit to Mr. W. B. Rankine, one of the vice-presidents of the Niagara Falls Company, to see how the commercial developments at Niagara were progressing; and I believe that a concise statement may be of interest to your readers. In June, 1892, and again in December, 1894, when the first works were nearing completion, I gave the *Times* some account of what was being done, and since then the public has taken much interest in similar electric developments of water-powers.

It is four years and a half since I was last here, and the first thing to strike one is the great number of enormous new factories which have been established on the company's land. Nearly every one of these consumes a very large amount of power, as is shown by the following statement, which anyone can verify, showing the names of the factories and the amount of power used in each:—

	H.P.
International Paper Company	7,200
Pittsburg Reduction Company (aluminium)... ...	3,050
Carborundum Company...	1,000
Buffalo and Niagara Falls Electric Light Company...	500
Electro-Chemical Company (peroxide of sodium) ...	400
Buffalo and Niagara Falls Electric Railway	200
Niagara Falls and Suspension Bridge Railway ...	250
Buffalo and Lockport Electric Railway	350
Oldbury Electro-Chemical Company	1,000
Mathieson Alkali Works	2,000
Cataract Power and Conduit Company (Buffalo) ...	8,000
Tonawanda Power Company	500
Union Carbide (of Calcium) Company	10,000
Surface Coating Company (enamelling)	20
Niagara Development Company (workmen's dwellings)	75
Niagara Waterworks	45
Total	34,590

To these additions are to be made in October, and two new works, the Atchison Graphite Company and the Lead Reduction Company (Litharge), will be supplied, bringing the total up to 45,190 H.P. contracted for, bringing in an income of over £150,000. The operating expenses do not exceed £35,000 per annum.

This is a most interesting result in three ways—(1) It shows that the original promoters were right in believing that the locality, with cheap railway transport, was favourable; (2) it shows that the general plan of the works, by which any customer could have any kind of electric current he desired, has been appreciated; and (3) it gives an indication of the enormous strides which have been taken of late years in electro-chemical and metallurgical processes.

Regarding the machinery, the dynamos, which were totally new, not only in size but in their general design, never give the slightest trouble; and the transformers, ranging up to 2,500 H.P., have answered their purpose perfectly, even with the low frequency of alternations, which was generally condemned by theorists when I introduced it, but which is recognised now by everyone at Niagara as contributing largely to the success of the scheme. The rotary transformers, for converting alternating into continuous current, which are used for nearly half of the power, gave some trouble at first, being the first which had ever been commercially used. But the difficulties have been successfully met. A good deal of the other machinery was of a new character and bold in design, but has generally worked well. The setting-up and working of the transmission line to Buffalo reminds one of the earlier electric light stations in the United States, but this is bound to be one of the most important applications in the future.

The general conclusion arrived at, after thoroughly inspecting everything under the best auspices, is that the boldness of the originators of the scheme has been justified, and that the wants of manufacturers who require power in any form can be supplied. It must be remembered, however, that much depended upon the favourable locality, and this warning may be given, that it would be rash to develop a large water-power in this way without demands for power. At the inception of all these schemes there is one thing more important than overcoming the engineering difficulties, and it consists in ensuring the support of those who require large quantities of power, electrical or mechanical.

GEORGE FORBES.

Niagara Falls, *August 4th.*

Appointment.—The Oldham Surveyor's and Tramways Committee received 17 applications for the appointment of an assistant to Mr. Pickering (surveyor) in connection with the tramway works. Mr. Harry Clegg, of the Sheffield City Surveyor's office, has been appointed.

Institution of Electrical Engineers.—The following notice has been issued by the Council:—

In accordance with the Standing Orders of the Council, papers offered to the Institution are, on receipt, submitted to Council referees for report. If subsequently accepted by the Council, they are either read and discussed at an ordinary general meeting, or are published as original communications in the *Journal*. The Council, subject to the usual conditions, offer the following premiums for the session 1899-1900:—For papers read before the Institution—The Institution Premium, value £25; the Paris Electrical Exhibition Premium, value £10; the Fahie Premium, value £10. For original communications, not read at a meeting, but published in the *Journal* of the Institution—One premium, value £10; one premium, value £5. The next award of the Willans Premium by the Institution of Electrical Engineers will be made in December, 1903, and all eligible papers read before the Institution from January, 1898, up to that date will then be taken into consideration.

The Council will be pleased to receive communications on the following or other suitable subjects:—

1. Best methods of generating steam and steam power for variable loads. 2. Comparison of double and triple-expansion engines for varying load conditions. 3. Automatic handling of fuel in power stations. 4. The present position and applicability of gas or oil engines for electrical power stations. 5. Description of plants for the utilisation of water or wind-power in the generation of electrical energy. 6. The present position and prospects of the application of liquid and of powdered fuel in electrical power stations. 7. The utilisation of blast-furnace gases or other waste products of manufactures in the generation of electricity. 8. The application of dust destructors to the generation of electricity. 9. Electric light and power station chimney shafts; specialities of their construction and equipment. 10. Experiences with vibration from electric light and power stations. 11. Bearings of shaft and shafting running at high speed. 12. Improvements in dynamos. 13. Comparison of speed and cost of dynamos. 14. Comparison of single and multiple central stations. 15. The wholesale supply of electricity to towns and factories from centres where very large generating units are employed. 16. The distribution of electrical energy from a distant generating station through districts served from a different source of supply, or under a separate local authority. 17. Examination of relative advantages and disadvantages of direct current and alternate current transmission. 18. Examination of relative advantages and disadvantages of two-phase and three-phase transmission. 19. Methods of controlling speed of alternating current motors. 20. Practical methods of measurement in connection with polyphase distribution. 21. Methods for the conversion of direct current into alternate current. 22. Methods of providing for electrical supply during hours of small demand. 23. Utilisation of lighting plant for other work during the hours of small demand. 24. The electrical equipment of large blocks of offices in a city. 25. Description or comparison of systems of house wiring. 26. Economy of design in the manufacture of small electric fittings. 27. Portable electric lamps of the "safety" type, or otherwise. 28. Enclosed arc lamps. 29. Improvements in incandescent electric lamps. 30. Incandescence electric lamps with filaments other than pure carbon. 31. Application of electrical transmission in factories:—(a) Detailed description, giving sizes of motors and power provided. (b) Comparison of separate or combined direct and alternate current methods. (c) Combination of light and power for such purposes. 32. Electricity meters. 33. Description of electrical methods, or comparison of these with other methods, of propelling vehicles. 34. The supply of electrical energy for tramway purposes. 35. The use of electrical methods of traction on railways served by steam-driven locomotives. 36. The economy and design of electric elevators. 37. The design and economy of electrically-driven pumps. 38. The utilisation of electrical energy in mining. 39. The applications of electrical energy in warfare. 40. The use of electricity in the textile and other industries. 41. The application of electricity in musical instruments. 42. Electro-therapeutics. 43. The establishment of public time services by electricity. 44. Recent advances in telegraphy. 45. Applications of alternating currents in telegraphy. 46. The transmitting capacity and load factor of telegraph circuits. 47. Hertzian telegraphy. 48. Methods, in aerial telegraphy, of restricting signals to selected stations. 49. Recent improvements in telephony. 50. Descriptions of systems tending to simplify the interchange of telephonic communications. 51. The talking capacity and load factor of telephone circuits. 52. The application of electricity to the generation of heat for domestic purposes (cooking, ventilation, heating, &c.). 53. The construction and use of electric furnaces. 54. The application of electricity to the welding or annealing of metals. 55. The application of electrical heating methods in chemical or metallurgical operations. 56. The applications of electricity in metallurgical processes. 57. The applications of electrolysis in the smelting or refining of metals, or in the chemical industries. 58. The electrical equipment of chemical factories. 59. Chemical generators of electricity theoretically considered from a practical standpoint. 60. Improvements in and applications of primary batteries. 61. Examination of the present position of secondary batteries in electrical engineering. 62. Secondary batteries with plates other than lead. 63. The economic employment of thermo-generators. 64. Improvements in the apparatus for producing, and in the applications of, cathode and Röntgen rays. 65. The relative suitability and efficiency of the different materials available for any of the requirements of electrical engineering. 66. The electric strength of di-electrics. 67. Recent advance in the manufacture or use of insulating materials. 68. New insulating materials. 69. Electrical applications of aluminium, sodium, &c. 70. The electrical uses of the rarer metals. 71. The treatment, testing, specifications, or uses of iron or steel, or of iron alloys, for magnetic purposes. 72. The manufacture of permanent magnets. 73. The relation of chemical composition and physical condition to the electrical or magnetic properties of substances, considered in its bearing upon electrical engineering practice. 74. High resistance metals for instruments or resistance coils. 75. New resistance alloys. 76. The protection of laboratories and observatories against magnetic disturbances due to local causes. 77. Recent legislation in its relation to electrical undertakings. 78. The relations between electric lighting or power corporations and municipal authorities.

In Sheep's Clothing.—For many years we have directed the attention of our readers to the friendly financial relations which have existed between the Eastern Extension Telegraph Company and the Colonies from which this company derives the most considerable part of its income. Recent events have somewhat deranged this pleasant intimacy, and a policy of renunciation is now being adopted by those who were formerly the tyrants of the telegraphing public of Australasia. In the future there are to be no more subsidies. This announcement sounds well and reads well, but, in our opinion, any agreement which this cable company proposes to the Australian Governments requires the closest scrutiny. The Eastern group have only very recently abandoned a portion of their demand for subsidies of over £100,000 per annum for laying an "all-British" cable to Australia, with a branch to India *viâ* the Cape. Remembering the tenacity with which these companies have clung to State aid, as well as other points connected with their history, we decline to believe that this repentance is really heartfelt. Rather would we suggest that the Colonial Office should keep well advised of the arrangements concerning the the collection of telegrams which the Eastern Extension Telegraph Company are now attempting to conclude with some of the Australian Colonies. A joint-purse agreement between this company and South and West Australia at least might, were it considered among other conditions of Australian Federation, prove a serious difficulty in the way of the receipts of the Pacific cable, in the success of which the Colonial Office is interested. The following is from an Australian newspaper which has just come to hand:—

The Eastern Extension Cable Company has made an important proposition for an improved service between Australia and England. The company entirely waives its demand for a renewal of the subsidy of £32,400 per annum for 20 years in consideration of laying a cable from the Cape, and it does not now ask for a guarantee against competition, which it proposed in February, 1898. Further, in addition to providing a cable from the Cape all the way to Glenelg, *vid* Perth, the company will agree to at once reduce the tariff from 4s. 9d. to 4s. per word, and make a further reduction on a sliding scale as the traffic increases. In return for this the company only requires the same privilege in Perth, Adelaide, and Melbourne *as they have hitherto enjoyed in Great Britain, of directly distributing and collecting their international telegrams to and from the public.*

Fire in the Tape Shop at Messrs. Johnson and Phillips.—Early on Sunday morning last a fire broke out in the tape and insulation shop, which is one of the original buildings at Messrs. Johnson & Phillips. Several workmen were about at the time, and the hose was quickly connected up, but the fire spread so rapidly that the whole shop was soon in a blaze. Fortunately the wind was in the north-east, and so the general offices of the company escaped with only a few broken windows. We understand this particular department is very full of orders for the Eastern Telegraph Extension Company and Telegraph Construction and Maintenance Company, but we are sure that, with their usual energy, the firm will overcome the temporary difficulty, and within a few weeks' time be able to meet their most urgent orders. The building was not insured. Messrs. Johnson and Phillips write that the work in the electric light and power department and electric cable works will in no way be interfered with. By Tuesday they had been able to restart the greater portion of the machinery in the department concerned, and it was then hoped to have the rest of the plant in full work within the next 24 hours. The firm desires to thank its friends for the numerous sympathetic letters and offers of help received.

Personal.—As may be seen from our advertisement pages, Mr. Sydney F. Walker, who has for many years been connected with the electrical industry at Cardiff, is open to accept an engagement.

We learn that Mr. Charles Bright, F.R.S.E., is shortly to marry Miss Isabella Charlotte Gosling, of Hassobury, Essex, and Portland Place.

The freedom of the borough of Carnarvon is to be conferred upon Sir William Preece on Thursday, September 21st. A banquet follows the ceremony.

Negotiations with Prof. Röntgen, as to his acceptance of the Professorship at the University of Munich, are still proceeding.

The Trade Union Congress and the A.S.E.—The Amalgamated Society of Engineers has been suspended from the Trade Union Congress for two years. The reason is that when the smiths at Tyne Dock struck work because a poor boy, who had served a rather broken apprenticeship, was put to a fire, the A.S.E. allowed their members to take the strikers' places—a proceeding contrary to the rules of Trades Unions. One union must not thus interfere with another, however unjustifiable the strike may be. That the strike was unjustifiable we fully agree with Mr. Barnes, but, and we

confess to a strong bias against the ways of Mr. Barnes, we do not feel that Mr. Barnes's new-found zeal for the unfortunate and lowly placed is altogether what it appears on the surface. During the progress of the great strike of 1897, we frequently expressed our sympathy with the labourers of the engineer's shop, often men of infinitely better education than the tradesmen. At that time did we find any zeal in Barnes for an unfortunate class? Now he overflows with pity for one solitary individual who has not even the burden of a wife and family. We think there must be a nigger in the wood pile. It is matter of common knowledge that the general body of trades unions resented the high-handed action of the A.S.E. in 1897. The A.S.E. had waxed fat and gross, and would be a king among the unions, and this affair of a poor smith's apprentice boy seems to be merely the opportunity of getting even with the A.S.E. on the part of the other unions, while Mr. Barnes's sympathies with the boy, come in well to back up his conduct in letting his members fill up the places of strikers—also probably an aftermath of 1897, when Mr. Barnes did not feel he had the support he desired. Considering the way in which trades unionism has been carried on for some years, it is perhaps as well that they should fall out, by the way, amongst themselves. There is an old proverb which says that honest men get their own under certain circumstances. At the same time it is to be regretted that trades unionism should have fallen to so low an ebb. Trades unionism has its proper and legitimate functions, and employers are by no means immaculate, and because of this, is it the more important that the trades unions should so comport themselves as to retain the public sympathy. It is, after all, to public opinion—not to their war chest—that a trade union must look when it fights. If public opinion upholds it, no combination of employers can resist a demand by a trades union, and similarly, no secretary of a union, be he ten times less careful of funds than Mr. Barnes, could hope for success unless he had a much better excuse for war than that put forward to excuse the error of 1897. We little thought two years ago to be able to record to-day any expression of Mr. Barnes's feelings on behalf of the oppressed. It is possible Mr. Barnes has turned over a new leaf? If he has really done so, and honestly intends to live up to the blessed doctrine which he now professes, for his protests are almost paraphrases of our own expressions of two years ago, then we are willing to bury the hatchet. Unfortunately, however, Mr. Barnes claims retrospectively a position for the A.S.E. in which we cannot for a moment admit it took its stand. The A.S.E. cared for no one outside its own members, and not very much for them. The fight of 1897 was engineered by a clique for particular purposes, and the individual members had less say in the matter than a drummer boy in the army has over a plan of campaign.

Appointments Vacant.—An electrical assistant is wanted for the electrical engineering department at Hartley College, Southampton. See "Official Notices" this week.

The Wakefield Corporation wants a junior assistant electrical engineer and a dynamo and switchboard attendant. See "Official Notices" this week.

The King's Lynn Corporation want an assistant electrical engineer for the electricity works. See "Official Notices" this week.

Simla Water-Power Scheme.—A *Pall Mall* Simla correspondent writes with reference to the Simla water-power scheme which is shortly to be taken in hand by a London syndicate. It seems that at Bilaspur a cutting through a neck of land round which the river now makes a detour of some eight miles will give a head of 300 feet, with the whole volume of the Sutlej River behind it. The power, therefore, is practically unlimited. It is to be developed by turbines set at the bottom of the fall, and converted into electricity to be utilised partly on the Kangra Valley Railway, the North-Western, and partly on the Simla-Kalka Railway, the balance being taken on to Lahore and Simla for electric lighting and other purposes.

Electrician's Insulated Screwdriver.—The American *India-Rubber World* describes the screwdriver shown in the drawing, a patent for which has been applied for by Messrs. F. E. Ducharme & Son, of Shelbourne Falls, Mass. The handle of the tool is insulated with hard rubber, the latter

being made to surround entirely the portion of the blade in the wooden handle. The whole is said to be so well fitted, and the rubber is so fastened that no part can become loose or pull out from use. It was designed for use by electricians, though it is adapted for all purposes for which a screwdriver is desired, the cost being only a very little more than for the ordinary non-insulated screwdriver.

CITY NOTES.

Dublin United Tramways Company.

The directors' report, submitted to the shareholders at the Imperial Hotel, Dublin, on Tuesday last, says that the directors have declared a dividend at the rate of 6 per cent. per annum on the preference shares, and at the rate of 5 per cent. per annum, free of income-tax, on the fully paid ordinary shares, numbered 1 to 17,150, and at the same rate on the sums paid up on account of the fully paid ordinary shares, numbered 17,151 to 51,450. This dividend will absorb £29,401 4s. 7d., leaving a balance of £484 10s. 11d. to be carried to next account. Out of the profits of the half-year dividends have had to be provided on a considerable amount of capital which is not yet remunerative. The directors report that the reconstruction of the tramways, the laying of the underground conduits and cables, and the erection of the overhead electrical equipment throughout the whole system, are practically completed, and they expect that power will be available before the end of this month from the new generating station at Ringsend, to operate by electricity the remaining lines which are now worked by horses. Mr. William Anderson, the secretary and manager, having resigned these positions, has been co-opted to the vacancy in the board created by Dr. Carte's death, and appointed managing director. The positions held by Mr. Anderson have been filled by the appointment as secretary of Mr. R. S. Tresilian, formerly assistant secretary, and as manager of Mr. C. W. Gordon, a gentleman of large experience in tramway management. Mr. Wm. M. Murphy has been elected chairman of the board of directors. The dividend warrants will be sent out on 31st inst.

The ordinary general meeting was held at Dublin on Tuesday, Mr. William Murphy presiding.

The Chairman, in moving the adoption of the report, said that as the result of the operations for the past half-year, they were enabled, after paying all the fixed charges, including 6 per cent. on the preference capital of £600,000, to repeat the dividend of 5 per cent. on the ordinary shares of the company. The secretary had calculated that not less than £385,000 of their capital expenditure in relation to the electric charges was unproductive during the past half-year. During the period the company's cars travelled 2,445,802 miles, carrying 16,851,309 passengers, on the three electrical lines in operation—namely, Donnybrook to Phœnix Park, Nelson's Pillar to Dalkey, and Nelson's Pillar to Dollymount. The total expenses were £23,308, while the amount earned was £45,471, showing that the working expenses were just 51 per cent. of the passenger receipts. He believed the change from horse-power to electricity would increase the profits threefold. In a few days the Rathmines line would be worked electrically, and in a couple of months or so the horse system of working their cars would be relegated to the domain of ancient history. Having referred to the authorisation by the Privy Council of some new lines of tramway in the city and suburbs, the chairman said the trolley scare got up by certain newspapers was really a clumsy piece of journalistic work. Nobody, he said, now paid any attention to the sensational statements "which have so often been found to be pure invention or gross exaggeration." The directors were fully alive to the necessity of taking every precaution that care and science could suggest for the safety of their passengers and the public, and they believed they had succeeded well having regard to the tens of thousands of miles the cars travelled and the millions of passengers they carried. Constant improvements were being made, the latest being a new trolley head, the invention of their electrical superintendent, Mr. Towell. He had been asked, with reference to the town clerk's letter, which had appeared in the newspapers, whether the Corporation had power to compel the company to put three men on each car. His answer was that they had not. The chairman mentioned that the directors intended to introduce a system of stopping the cars at fixed places (a plan which works well in Glasgow, Leeds, and elsewhere).

The report was adopted unanimously.

The Chloride Electrical Storage Syndicate, Limited.

The directors in their report for the year ending June 30th, 1899, say:—"During the year the business of the syndicate has continued to increase, as will be seen from the diagram which accompanies this report. In order to cope with the continuously increasing demand the works have been still further enlarged and considerable additions made to the plant. The ground lease of the land on which the works stand has also been purchased during the year. The users of the battery still continue to express their full confidence in its merits, and this is best evidenced by the large number of repeat orders which are constantly received. Many new customers have also been added both in this country and abroad. Since the date of last meeting the directors have entered into a revised arrangement with the Electric Storage Battery Company, of America, which they consider will be to the advantage of the syndicate. The balance-sheet, as required by the articles of association, is enclosed with this report, and from this it will be seen that the profits for the year, including the surplus on the sale of certain patents and shares, after providing for debenture interest, amount to £13,487 1s. 5d., which the directors consider satisfactory, especially when the large increase in the cost of raw material is taken into consideration. After writing off from several accounts £5,160 16s. 9d. (an amount which the directors think necessary) there remains a balance of £8,326 4s. 8d., to which must be added £2,903 5s. 10d. brought forward from last year, making £11,229 10s. 6d. After deducting the cumulative dividend of 7 per cent. up to June 30th, 1894, upon the "A" shares allotted prior to that date, paid by the directors in November, 1898, and March, 1899, the directors propose to carry forward the balance, out of which a dividend may be paid at their discretion. The first mortgage debentures have been paid off, and a fresh issue of £20,000 completed. The retiring director under the articles of association is Mr. A. R. Harvey, who, being eligible, offers himself for re-election. The auditors, Messrs. Parkinson, Mather & Co., also retire, and offer themselves for re-election.

The meeting is to be held at the Works, Clifton Junction, near Manchester, on Tuesday, August 29th.

The Brush Electrical Engineering Company, Limited.—The directors have decided, subject to audit, and after placing £5,000 to the depreciation reserve fund, to recommend payment of a dividend to the preference shareholders at the rate of 6 per cent. per annum for the half-year ended June, 1899, (making the full dividend of 6 per cent. on the preference shares for the year) and a dividend at the rate of 5 per cent. on the ordinary shares for the year, leaving a sum of about £5,000 to be carried forward to next account. The share transfer books of the company will be closed from August 28th, 1899, to September 8th, 1899, both inclusive.

British Westinghouse Electric and Manufacturing Company.—At an extraordinary general meeting of this company held at Cannon Street Hotel yesterday (Thursday), a resolution passed at a meeting held on August 9th, altering Article 83 with respects to powers for appointing directors, was confirmed. Mr. Benson presided.

Stock Exchange Notice.—Application has been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to Hampstead Electric Supply Company, Limited—13,334 ordinary shares of £5 each, and 13,334 5 per cent. preference shares of £5 each.

House-to-House Electric Light Company.—An extraordinary meeting of this company was held at Winchester House yesterday afternoon to confirm resolutions passed at a previous meeting altering the name of the company.

Nernst Lamp, Limited.—A meeting of this company was held on Wednesday at Winchester House to confirm the winding-up resolutions passed at the last meeting, and recorded in our issue of August 4th, page 203.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending August 19th, 1899, were £1,919 7s. 4d.; receipts for week ending August 19th, 1898, £1,295 18s. 5d.; aggregate for half-year to date, £9,900 11s. 4d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending August 18th, 1899, were £3,484 14s. 2d.; corresponding period 1898, £2,941 4s. 2d.; decrease, £456 10s. 0d. Visit of Barnum and Bailey's Show three days last year.

The City and South London Railway Company.—The receipts for the week ending August 20th, 1899, were £1,080; week ending August 21st, 1898, £1,044; increase, £36. Total receipts for half-year, 1899, £7,746; total receipts corresponding period, 1898, £7,828, decrease, £82. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending August 19th, 1899, were £221 13s. 5d.; week ending August 20th, 1898, £272 15s. 11d.; increase, £48 17s. 6d. Total receipts to date, 1899, £6,141 4s. 3d.; corresponding period, 1898, £4,979 8s. 3d.; increase, £1,161 16s. 0d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,916; 1898, 3,744. Number of cars, 1899, 12; 1898, 10.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 20th, 1899, amounted to £1,695; corresponding week last year £1,664; increase, £31.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 18th, 1899, were as follows:—D. U. T. Co., horse cars, £2,244 19s. 10d.; ditto, electric cars, £1,316 2s. 8d.; D. S. D. Co., electric cars, £1,157 10s. 8d.; total, £4,718 12s. 4d.; corresponding week last year—D. U. T. Co., horse cars, £3,016 5s. 10d.; ditto, electric cars, £646 16s. 0d.; D. S. D. Co., electric cars, £1,218 14s. 1d.; total, £4,881 15s 11d.; decrease, £163 3s. 7d. Aggregate to date, £32,369 10s. 2d.; aggregate to date last year, £31,802 5s. 4d.; increase to date, £587 4s. 10d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The South Staffordshire Tramways Company.—The receipts for week ending August 18th, 1899, were £712 13s. 1d.; aggregate receipts for 33 weeks, £21,667 4s. 0d.; week ending August 19th, 1898, £735 19s. 2d.; aggregate receipts for 33 weeks, £20,689 2s. 4d.

STOCKS AND SHARES.

Wednesday Evening.

While business still shows itself shy of returning to the electric market, a continuance of the firm tone upon which we commented last week is still the principal feature. Holders of Electricity Supply shares are recovering from their recent nervousness, and show a marked disinclination to accept any sort of a price which may be offered when they want to sell, although it was only a few weeks back that they were grateful to come across a buyer at all. The shares showing the biggest rise on the week are House-to-House and Westminsters, each of which is 10s. to the good, and the former company is finding supporters at last. There has been a fairly brisk demand for Edmundsons, and buyers have also come along for Charing Cross Preference, which, at the present price, yield about 3½ per cent. to the purchaser. A further call of 30 per cent. has been made upon County of London 4½ per cent. Debenture stock, and the price has fallen a point, some of the holders electing to sell their scrip rather than pay the instalment. The market for Citys is very quiet, but the shares have developed a stronger tone, and there are a few bears about in the market.

A correspondent asks us some questions about the Smithfield Electric, and as many of our readers are interested in this concern, we may here state that the price of the shares is 3¼—3⅜. They are much easier to buy than to sell—in fact, the last seller who appeared in the market only got £2 a share. Since then the price has improved a little, and the Debentures have also moved up to about 90. No official quotation exists for either description. We should not recommend the shares for an investment, and the price of the Debentures points conclusively to the fact that the security is not altogether "gilt edged."

The principal feature in the telegraph market is the advance which has taken place in the Anglo-American Telegraph Stocks. This is due mainly to the increased activity in the American railway market. A "Yankee boom" being invariably productive of good business to the Anglo-American companies. No alteration, however, has taken place in the prices of Direct United States or Commercial Cable stocks. Eastern Ordinary is once more on the up-grade, and it is understood that the company has benefitted, rather than the reverse, from the calamity in the West Indies.

The West Indian Telegraph stocks are all steady, but, of course, there is not much inducement to buy until it is known definitely how much damage has been done to the company's lines. A bull point, however, is afforded by the announcement that two of the companies have now restored their rates to the West Indies, which it is hoped will bring about some acquisition of fresh business. Globe Telegraph have recovered the 5s. which they shed a fortnight ago.

We have repeatedly called attention to the excellent prospects which appear to be in front of the Electrical Manufacturing Companies, and although the market in these is very restricted, there has of late been a distinct tendency to put prices better. This week it is Callender's which have risen, and the Preference are quoted 5⅞. Brush Electrical shares have also enjoyed some little popularity, and the ordinary have managed to attain the price of 2½ middle. The increased dividend is largely accountable for the rise. British Electric Traction are inclined to dulness, and the Preference have fallen ¼, despite the fact that the company has entered into negotiations with the Leamington and Warwick Tramways, which should prove remunerative to the former.

The chairman of the London General Omnibus Company in his speech at the meeting last week, threw out a most interesting hint with regard to the future traction to be adopted by the company, expressing his opinion that "electricity would come some day." Should any change be found conducive to the shareholders' interests, he added, the directors would not be long in making it.

Barcelona tramway shares remain at 12—14, although no dividend is forthcoming on them. Now that the whole of the company's lines, with a small exception, are being worked electrically, some return to prosperity may be anticipated. Buenos Ayres and Belgrano "A" Preference are unchanged at 4½, and the market for provincial trams is very quiet.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, August 16th.	Closing Quotation, August 23rd.	Business done during week ended August 23rd, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	62 — 65	63 — 66	63¾	63½
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114 —115	115 —116	116	115
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13⅜— 14½	14½— 15	15	14½
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15¼	15 1/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3 xd	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	104¾
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,009	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	4	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3¼%	11⅜— 12¼	11⅜— 12¼	12¼	12
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	151 —156	153 —158	156	153
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	98 —102	99 —102	100½	99½
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104 xd	101 —104	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	116 —121	118	114½
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 15	14⅜	14½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
820,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	114 —119	115 —120	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	103⅛	103
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	10½— 11	10⅝— 11½xd	10 1/16	10¾
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½xd	...	...
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30¼	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5¼— 5½xd	5¼— 5½xd	5 7/16	5 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14 xd	13⅜	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14 xd	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½xd	5⅜	5¼
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100½	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	⅞	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	106½	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	5⅛	5
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Brаz. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	1 %	1⅝%	...	1⅜— 1⅝	1⅜— 1⅝	1½	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	10 5/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11 xd	10 — 11 xd	10⅞	10½
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6½	6 — 6½xd	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	113 —115	113 —115	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	12	11 9/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½xd	12½— 13½xd	12 13/16	...
400,000	Do. 5 % Deb. Stock, Scrip. (ins. at £115) all paid	...	5 %	5 %	...	123 —128	123 —128	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13½— 14½	...	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	51 — 53	81 — 83	82¼	82
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5½— 5⅝	5 — 5½xd	5¼	5 3/16
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½xd	8 — 9 xd	8½	8 1/16
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10 xd	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16 xd	15 — 16	15	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½xd	14½— 15½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16 — 17	16 — 17	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9⅜	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	4	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½—15½	15 — 16	15⅜	15 9/16

* Subject to Founder's Shares.
† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Aug. 16th.	Closing Quotation Aug. 23rd.	Business done during week ended Aug. 23rd, 1899. Highest	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3¼xd	3 — 3¼xd	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	17½— 18½	17½— 18½	18⅝	18¼
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	13¾— 14¼	14 1/16	13⅞
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	...	...	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	128½	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	nil	...	1⅝— 2	2 — 2¼	2⅛	1 15/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	nil	4 %	...	2⅛— 2⅜	2⅛— 2⅜	2¼	...
125,000l	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	13 — 14	13½— 14½	14	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 10⅝	10½— 10⅝	10⅝	10 7/16
178,303	Do. do. do. £8 paid	10	...	...	...	8½— 8¾	8½— 8¾	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	2½— 3½	2⅝— 3½	3	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5½— 5⅝	5½— 5⅞	5½	...
630,000l	City and South London Railway	Stock	1 1/16 %	1⅞%	2⅛%	65 — 67 xd	65 — 67 xd	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6⅝	6½— 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛%	6 %	6 %	1⅝— 2¼xd	1⅝— 2¼xd	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛%	6 %	6 %	4 — 5	4 — 5 xd	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼— 2⅜	2¼— 2⅜	2⅜	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000. ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
21,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600l	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	20 — 22	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	113½	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	...	...
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	103	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	3½%	3½%	7⅜— 7⅞	7⅜— 7⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 14	13½— 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	38 — 42	40½	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9½— 9⅝	9½— 9⅝	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
540,000l	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	102 —105	102 —105 xd	103½	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8½—9½.
British Aluminium, Ordinary, 9—10; 7 % Pref., 10—11.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 106—109. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 5/16—7/16.
Smithfield Market Electric, 2—4.
*T. Parker, £10 (fully paid), 19.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, August 23rd.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	85/-	85/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a " " " .. .. per ton	£23	£24	£1 dec.
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25	£25	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	5½d.	5½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 3" to 12") basis per lb.	8½d.	8¼d.	..
c " Tube (brazed) .. .. per lb.	10½d.	10¼d.	..
c " Wire, basis .. .. per lb.	..	8¼d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. . .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g " Wire (basis price) .. per lb.	10¾d.	10¾d.	..
g " Sheet .. .. .. per ton	£88	£88	..
g " Rod .. .. .. per ton	£88	£88	..
a German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/3	4/3 to 4/3	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	65/-	63/6	1/6 inc.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£13 15	£13 15	..
g Lead, English Ingot .. .. per ton	£14 10	£14 10	..
g " " Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 7	£8 7	..
d Mica (in original cases), small per lb.	1½d. to 6d.	1½d. to 6d.	..
d " " " medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " " large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	to £40	From £15	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£146 10	..
g " foil .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j " Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 160 lbs. rove .. per ton	£12 10	£12 10	..
j " Manila, 24 thread .. per ton	£35	£35	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£28	£28 10	10s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

UNFAMILIAR APPARATUS.

The receipt of a large illustrated sheet of Blake's, of Accrington, hydraulic rams, brings to notice an unfamiliar appliance. Few know of the hydraulic ram, though there are considerable numbers in use. We believe the hydraulic ram was invented by Montgolfier. Its principle of action consists in allowing a considerable body of water to flow down hill in a pipe of some capacity and suddenly stopping the outlet. The descending water cannot be thus instantly checked, and its stored energy, being considerable, manifests itself as pressure, this being sufficient to open a small additional escape valve which communicates with an escape pipe up which a small quantity of the water is caused thereby to flow to a considerable height. The apparatus has no moving parts, except the large and small escape valves, the first of which is held open against the large flowing stream by a light spring or load, and closes when the decending stream attains such a velocity as to overcome the spring, while the second is kept shut by the pressure in the delivery pipe and only opens during the short period when the pressure in the outlet vessel is momentarily increased. Hydraulic rams are of two varieties; those in which part of the actuating water is delivered for use, and those in which an impure supply of water may be used to force a pure water up the delivery pipe. A ram may be counted upon for an efficiency of at least 50 per cent., and even 75 per cent. is claimed to be at times secured under favourable conditions. As rams call for no attention and will work continuously, it is surprising how a constant small supply aggregates during a 24 hours' day. Rams are made to give as much as 400,000 gallons per day, and rams are made that will force water as high as 800 feet. It is very much a question of proportion. To the engineer, the interest of the ram is that it can be employed in situations where any other form of water-raising apparatus would be much less suitable, and it can thus be conveniently used to force water from a distant stream to a steam-power station. As a rule, in this country a ram will be unaffected by weather. They are usually placed in a brick chamber, well protected by earth banking from frost, and their supply can generally be drawn from the stream at a protected point, sufficiently so to ensure constant working so long as there is a flow in the stream. We have ourselves known hydraulic rams to have been at work many weeks without even being seen during the time. We think station engineers might with advantage consider the question of using rams under certain circumstances.

CO-OPERATIVE PRODUCTION.

It is an easy matter for the working man to combine for purposes of purchasing and distributing goods. When he does so we do not find that he inquires too curiously into the origin of the goods he purchases nor as to whether they have been produced by sweated labour!—all he appears to care for is that the price shall be low and the quality high, and the bonus, or dividend, or surplus, call it what you will, shall be high. But co-operative production has far less attraction for him, and this was well brought out by Mr. Gerald Balfour when opening the Exhibition of the Labour Association for Promoting Co-operative Production on the 15th inst. From the tenour of Mr. Balfour's remarks, it would appear that he regarded the comparative failure of co-operative production as due to the fact that the co-operative societies, unlike the joint-stock company, did not employ the highest talent to be obtained, they did not pay the necessary salaries, and they did not invest the manager with the necessary supreme authority to command success. These necessary elements of success do not commend themselves to the workman who, as a small shareholder, is also, perhaps, a low-paid worker. He is apt to consider himself as badly treated if ordered about by the manager, who, perhaps, holds no shares. The so-called Co-operative Cotton Mills of Lancashire are often held up as examples of what can be done in the way of co-operation, but they are not fair examples. They are not strictly co-operative concerns, but are really only joint-stock companies with a free market for their shares. Mr. Balfour counselled moderation in the undertaking of production by co-operators. He pointed out as above and otherwise that co-operation involved several weak points, and his advice was to restrict co-operative efforts, for a time at least, to such industries as involved the fewest of such weak points. Curiously enough, though the statistics of English and Scotch co-operative production were not favourable, in Ireland they were better. Though the Irish movement was only 10 years old, there were already 400 co-operative societies in Ireland—banks, agricultural societies, but chiefly, we believe, dairies. Those who know anything of the conditions which obtain on an Irish farm, and the absolute heedlessness of dirt, cannot but appreciate well the reasons for the defeat of the Irish by the Danes. Equally will they appreciate the great advantage of the clean built dairy away from farm buildings, to which each small farmer may bring his few gallons of milk, and have it converted, in a cleanly manner, to a marketable article. But after all, the co-operative dairy in Ireland was undertaken by men who did not seek employment in the dairies; they are themselves the producers of the raw material, which we presume they are credited with, according to its value, by lactometer or other recognised system. As Secretary for Ireland, Mr. Balfour no doubt has had opportunities for gaining an insight into the Irish movement, which he so well referred to, and with which he rounded off his speech. But while we fully recognise the great benefits to be obtained from co-operative dairies in Ireland, we see, as we fully believe Mr. Balfour sees, that this is no real argument for a general co-operative production. It is really an argument for production on a larger scale than is possible to the owner of only two or three cows; it is an argument for cleanliness, for probably the majority of small Irish farmers have not a sufficient supply of clean water to hand, whereas the dairies are able to afford the expense of a bored artesian well, and of steam for cleaning utensils. They can afford De Laval separators; but a co-operative engineering shop cannot afford anything that is not within the reach of a wealthy private firm or of a joint-stock company. None of the reasons usually advanced in favour of co-operation operate to make Irish dairies a success. The Irish dairies employ paid servants, who are not co-operators in the sense of being proprietors, and any private capitalist could establish a dairy with equal success, and many would do so but for fear that some fine day their raw material would be withheld from them without reason. They would awake to find they had been boycotted for some fancied wrong they had done. The small farmers are not likely to boycott their own dairy, which must succeed if only it be kept clean. What they need is a sense of the presence of dirt. This sense seems to be strangely absent. Toleration of the stranger is also required; a stranger may do his best to establish an industry, and he will meet with every possible form of obstruction. There is no incentive to lay out capital in such a country, and the result is the general ruin which is so apparent in the South and West. The success of the co-operative movement in Ireland does prove what is possible in the country, but it tells us only too plainly that all this late success could have been achieved years ago but for the uncertainty under which capital is invested in Ireland. Exactly the same process has been going on in England for some years under the auspices of the Amalgamated Society of Engineers, and if the check of 1897 be not permanent, it will reduce English industry to as low an ebb as that of South and Western Ireland.

THE GLASGOW TRAMWAY ENGINE CONTRACT.

The following important letter on the above subject, to which we make reference at length in another column, appears in the *Manchester Courier*:—

"Soho Iron Works, Bolton, *August 16th*, 1899.

"Sir,—The *Manchester Courier* of to-day contains a paragraph to the effect that the Glasgow Tramways Committee had yesterday accepted the tender of an American firm for the engines required for the new power station at a price rather more than twice that tendered by a Glasgow firm of engine builders. We also submitted a tender for the engines, our offer being some £20,000 below the tender which is now stated to have been accepted, and we think we, and other British engine builders, may fairly complain of having been specially invited to incur the serious expense involved in the preparation of designs and estimates if it was a foregone conclusion that only the engines of one, and that an American, firm would satisfy the requirements of the committee and their engineer. Our experience in connection with this contract will probably be of interest to engine builders.

"On perusing the specification we found it to contain a number of anomalies which required explanation before we could prepare any reliable tender, of which the following are examples:—(1) Crosshead pins as large as, or larger than, the crank pins. (2) A piston rod 10 inches in diameter for both a single 88-inch low pressure cylinder and for each of the two 60-inch cylinders named as alternatives, the high pressure rod in each case being 9 inches in diameter. (3) A single 88-inch cylinder named as the equivalent of the two 60-inch ones, 85-inch being the actual equivalent, though a still smaller one might reasonably be used, owing to the loss by friction being less with the two-cylinder design. (4) A coupling apparently desired between the 100-ton fly-wheel and one of the bearings supporting it. (5) Crank discs, apparently of cast-iron, in place of the steel or wrought-iron cranks universally used in English marine practice for similar shafts. (6) A 32-inch crankshaft for transmitting 4,000 to 5,000 I.H.P. at 75 revolutions, against the 18-inch shaft which would about accord with English marine practice, the strengths of the two being as 5½ to 1. (Owing to the fly-wheel being interposed between the engines and the generator, the stresses on the crankshaft would be much less severe even under the conditions of electric traction than in the case of marine engines, liable to race in heavy weather.) (7) The suggested number of bearings and sections of shafting would not fit any usual arrangement of shafting that we could think of. (8) An oil pump specified to be of 'equal capacity' to a 2-gallon lubricator.

"With these anomalies before us, and being anxious to go fully and seriously into the matter, we sought and obtained an interview with the committee's engineer, visiting London for the purpose. No explanation was forthcoming, but it was pointed out that the dimensions, &c., were only 'suggested,' and we were requested to tender in accordance with our practice. This we did, submitting full designs and particulars, and adding—'We have given a great deal of consideration to the design and cost of the engines for which we have now the pleasure to quote you, being very desirous of obtaining the

order for them; but we fully recognised that even the somewhat voluminous papers we are now sending to you do not by any means cover the whole ground, and we wish to express our readiness and desire to have the opportunity of discussing the various points with your engineer, should our tenders be acceptable to your committee; and, in such case, we have no doubt that we could come to a full and satisfactory understanding as to both the general design and the details of the engines which are required.'

"We next received an official communication to the effect that whilst the total weight of our engines seemed satisfactory, our dimensions differed so much from those specified that it was desired to know whether we were prepared to accept the latter. We replied that the specification not being quite clear we could not give an unqualified answer, but asked an interview in order to arrive at an understanding. This being declined, we submitted further designs, explaining the nature of our difficulties, and offering to go further into the matter on being informed as to the wishes of the committee, also renewing our offer of a personal interview.

"On the evening of August 14th we received an official telegram from the town clerk, inviting our attendance at a special meeting of the Tramway Committee to be held the next day 'in order to explain any points in connection with our offer.' We gladly made a special night journey to Glasgow for the purpose, but, after waiting outside the committee room for some time, were told that the committee had declined to see any tenderers, and decided to recommend the acceptance of an American tender.

"So much is heard at the present day as to orders going to America which ought to be executed in this country that we think the above account of our experiences and the difficulties thrown in our way cannot fail to be interesting to other contractors as well as to the Glasgow ratepayers.

"We desire specially to call attention to the fact that in such a highly technical matter as that in question we were denied the opportunity of discussing or explaining a single technical point in connection with our tender or obtaining an explanation of difficulties involved in the specification. Whilst personally we received every courtesy from the officials with whom we came in contact, we must maintain that we as a firm were treated in an unbusinesslike and inconsiderate way, if only on the ground that we were invited to tender for, though apparently deemed incapable of carrying out, so important a contract. On this point we venture to quote an extract from a letter received from one of the most important South African houses, to whom we have supplied a number of large engines for gold mining purposes, and from whom, in view of this business, we asked a comparison of our own and American engines. After explaining that these engines are employed under very arduous conditions, they add:—'Coming to the point of the actual quality of material and workmanship, we may say that your engines are distinctly superior to the American engines that we have seen, and which cover those made by the leading makers in the States. For instance, where you employ cast and wrought-steel the Americans generally use cast-iron. We are bound to say that these American engines work well, but we are convinced that, in point of durability and the important question of repairs, they do not compare favourably with your engines, and in cases where stoppages would involve serious consequences, we should certainly prefer to put down one of your engines rather than any American engine we have seen, and we have had very considerable experience. We may inform you that the leading American engineers have inspected the engines supplied by you, and have expressed their admiration of same. As far as we are concerned, we can only express our entire satisfaction with the engines you have supplied us.'—We are, Sir, yours, &c.,

"For Hick, Hargreaves & Co., Limited,

"Andrew Reason, Secretary."

The E. P. Allis Company, of 39, Victoria Street, S.W., sends us the following copy of a letter adressed by it to the *Manchester Courier*:—

"August 22nd, 1899.

"To the Editor of the *Manchester Courier*.

"Sir,—We are builders of Corliss steam engines, and have for many years made a speciality of electric traction plant. In its interest we tendered to the specification issued by the Corporation of Glasgow for its tramway station engines. The Tramway Committee favourably considered our tender. The Council refused to pass the findings of the committee, and we are informed that a new competition is to be opened.

"We are, of course, unable to more than guess at the reason for such action. There was nothing in the specification at which anyone familiar with the demonstrated requirements of large electric traction plants could cavil. Naturally it did not follow British practice, for the exceedingly simple reason that there is no such application of electric power in the United Kingdom. It was simply a model plant, designed in the light of great modern experience, with a view to rendering the best economies to the municipalities to which it was offered.

"It was presumed by us that the committee to which the interests of the Corporation were committed knew what it was about, both in the selection of its engineers and in approving the specifications prepared by them. We did not think it necessary to visit Glasgow to make personal appeals to the members of the Local Government, or to resort to the columns of the public press for support while the matter was under consideration. We tendered absolutely to both alternatives of the specification, and we certainly believed that an American house, invited to an open competition by a great Corporation, might reasonably expect to be squarely and fairly dealt with.

"We repeat that the specification, as submitted to competition, embodied nothing but the results of the best accepted practice of similar installations. The only 'anomalies' discovered by our competitors arose out of their ignorance of the conditions that exist, and their inexperience of those methods of construction which have been found to best meet those conditions. Furthermore, every advantage lay with the British builder. The engines are special, therefore all who tendered were on the same footing as regarded design, plans, patterns, &c. The Allis Company were handicapped by a 1,000 miles of inland and 3,000 miles of ocean freights. Its engineers made that long and costly voyage to prepare their tender, not the 'special night journey to Glasgow' (from Bolton!), which one competitor so pathetically deplores in an open letter to the press.

"We did not take it upon ourselves to instruct the Glasgow Corporation as to how a cheaper and less substantial and effective machine might be secured for its use. It could afford to purchase the best thing that money could buy, and we were luckily in the position of having at our disposal the men and tools and facilities which could turn out the best—and the best was specified to us.

"Our competitors have devoted much time and space to a demonstration of the various methods whereby they proposed to apply data derived from marine and other practice to the needs of the Glasgow tramway plant. That discussion may be of absorbing professional interest, may possess charms to the student of acrostics or anagrams, but we regret to say that we are unable to discover its practical value or its relevance to the question under discussion. The modern tramway power plant has been developed from 15 years' experience with tramway plant, and from some 50 millions sterling which has been expended on such plants, and the day when workers on traction problems drew inferential designs from marine, or shop, or rolling mill practice is now ancient history.

"The long and short of it is, that instead of meeting the question openly and fairly, our competitors have endeavoured to bring such pressure upon the Glasgow Corporation as may induce it to accept an article of their manufacture, even if it be inefficient, unreliable, or antiquated.

"If that end be attained, we fail to see that any result is gained by the Corporation from the long and careful study of electric traction which has been made by the Tramway Committee and its engineers, involving expensive journeys to visit the representative modern systems of the United States and Europe.

"We feel ourselves aggrieved, and, we think, justly.

"Our tenders, prices, and specifications have been openly discussed and every advantage now given to our competitors. We can see little of that 'fair play' so hypocritically invoked in a 'competition' which is reopened whenever a home competitor fails to secure the contract, or in re-casting specifications until the favoured bidder finds them adapted to his limitations. To invite American houses to offer under such conditions is not only absurd but radically wrong. If the game is to be played under such rules it would be vastly fairer to exclude the American manufacturer altogether, and not invite him to expend his time and money needlessly.

"It is undoubted that a municipality has every right to decide to support home industry to the exclusion of all outsiders, but it may very properly be questioned whether the proper time to arrive at that conclusion is after outsiders, at the request of the municipality, have placed at its disposal all their data under the mistaken supposition that serious business was offered.

"Referring especially to Messrs. Hick, Hargreaves & Co.'s criticisms which were set out at length in your columns a few days ago, we beg to say that the various dimensions of pins, piston rods, and cylinders on which they animadvert, coincide very closely with the accepted best American practice in such engines, and we would repeat that there is no other source from which practical results can be drawn. It is useless to discuss why this be so, especially as we do not presume that you would care to have the whole theory and practice of steam engineering as applied to traction and wherein it differs from marine work, set forth at length in your columns.

"In our copy of the specification no mention was made of a coupling in the two-crank engine. One was specified in the three-crank engine, but it was between the outer bearing and the generator, not as stated by Messrs. Hick, Hargreaves & Co. All crank discs supplied by the Allis Company for such engines are steel, and the specification called for cast-steel throughout. They were not 'apparently cast-iron,' as Messrs. Hick, Hargreaves & Co. put it.

"Their statement as to proper strength of shaft is also incorrect. The shaft would have to stand a torsional strain equivalent to 10,000 H.P. or more (instead of the 4,000 or 5,000 H.P. they refer to.) It would also have to carry some 100 tons of fly-wheel. Messrs. Hick, Hargreaves & Co. evidently disregard the trifling fact that the necessary area of bearing and lubricating surface has something to do with shaft dimensions.

"That the suggested number of bearings would not fit any 'usual arrangement of shafting,' of which Messrs. Hick, Hargreaves & Co. have cognisance, is eminently possible. It is, however, one very usual in traction practice. Possibly, they may have overlooked that bearing between the 100-ton fly-wheel and the coupling, already referred to.

"We are naturally interested in the somewhat lengthy but exciting account of Messrs. Hick, Hargreaves & Co.'s various peregrinations and failures to meet the Tramway Committee and its engineers before their tender was considered. May we venture to suggest that 'the officials with whom they came in contact,' evidently went to a considerable length of politeness when an engine maker, who was confessedly chasing them down to get them to take something they did not consider met their needs, 'received every courtesy' at their hands. Our own experience leads us to believe that scant courtesy would usually be meted out under such conditions.

"We have no objection to the '6-inch ad. reading columns' which Messrs. Hick, Hargreaves & Co. have ingeniously worked into their letter. That is good business, and we are not at all above doing the same ourselves when opportunity offers. We have a book of those ourselves which we are prepared to distribute broadcast. It would

have been better though if Messrs. Hick, Hargreaves & Co. had taken their comparison between 'American' and English machines nearer home than Africa. The Allis Company now show a considerable number of engines of their make running in England, which are already available for purposes of comparison. By the end of this year, when the large plants we have now in hand for the Central London Railway, the Dublin, Bristol, Isle of Thanet, Sheffield, Cork, and London United Tramways, the London (Bankside and City Road electric lighting stations), and the Ellesmere Port Smelting Works are fairly finished, we shall be delighted to afford every opportunity for further comparison of design, material, and performance.

"We must, however, say that we note that Messrs. Hick, Hargreaves & Co.'s African friend can only compare their engines with the somewhat indefinitely stated 'American' type so far as 'material and workmanship' goes. Possibly the reason the Glasgow Committee approved of the Allis proposition was on the score of that economy in working and strength which the African gentleman does not touch on.

"At all events, we learn from Glasgow that our proposal surpassed all others in the guaranteed steam consumption, the weight and strength of the engines offered, and the rapidity with which delivery could be made. All good points, and well worth serious consideration.

"With our very sincere apologies for intruding so greatly on your valuable space, and like Messrs. Hick, Hargreaves & Co., 'appealing to your sense of fair play to insert this letter in your paper.'

"We are, Sir,

"Your very obedient servants,

"The Edward P. Allis Co."

The following letter appears in the *Glasgow Herald*:—

"Caledonian Hotel, Fort William,

"*August* 18*th*, 1899.

"Sir,—On a holiday in Scotland I have been following with interest the question of the Glasgow electrical tramways and the recommendations of their American engineer. Your report to-day is especially interesting reading, and if you will permit, I should like to make one or two remarks. Mr. Paton must be in ignorance as to what other countries in Europe have achieved in the matter of electric traction, or he would not state that 'almost the whole traction engines working for tramway purposes in the world had been made by American engineers.' Allow me to remark that on the Continent he would not find many American engines, but absolutely as good, efficient and economical machines by makers such as the Goerlitz Company (Germany), Franco Tosi (Italy), and Vanden Kerchove (Ghent). The Corporation of Glasgow, if real Free Traders, could therefore quite as well have asked any of the above Continental firms to tender, and I know they would have got quite as good an engine, delivered and erected within 12 months. But really there was no need to go outside the United Kingdom. Engineers such as Messrs. Hick, Hargreaves & Co., of Bolton, or Messrs. Browett & Lindley, of Patricroft, Manchester, could easily supply what was required without fear of constructing fly-wheels that burst, as they do in the U.S.A. But one cannot blame Mr. Parshall. As an American, with purely American experience, he has a bias in favour of engines he knows; and that is natural. Glasgow appointed him, and must take the consequences. To many of us engineers, however, it appears strange that the Scottish city did not consult one of the highest British authorities—namely, Prof. A. B. W. Kennedy, F.R.S., himself a Scotsman—than whom none probably has greater experience in matters relating to steam engines, as well as in matters electrical. I have the honour to be connected with the English branch of the largest German firm of electrical engineers, the 'Allgemeine Elektricitäts-Gesellschaft'; and, although we could have offered Glasgow quite as good a plant as any American firm, we did not tender, as it appeared a foregone conclusion that the orders would go to American firms, such as the Allis Company, the Thomson-Houston and Westinghouse Companies. Charles Weiss."

SOME COMMENTS ON THE HARTFORD LONG-DISTANCE TRANSMISSION PLANT.

By E. K. SCOTT.

The introduction of the rotary converter into practical electrical engineering has brought forward a number of special features, and one of the first papers to give particulars of these in any detail is that recently presented to the National Electric Light Association at New York by Prof. W. L. Robb. The author of the paper describes the conditions under which the two-phase transmission plant at Hartford is operated; the difficulties met with; the way they have been overcome, and the advantages which have been found in the combination of rotary transformers and accumulators for electric lighting.

As the system described is more or less on the lines which are about to be introduced at Manchester by the Metropolitan Electric Supply Company, the Blackheath and Greenwich Electric Supply Company, &c., the following summary of the main points in the paper, and the discussion, may be of interest:—

GENERATING PLANT.

Power is taken from the Farmington river, about 11 miles from the city of Hartford, and the water-power at present developed is capable of delivering 1,200 H P, the energy being transmitted by two-phase current at 10,000 volts and 60 cycles per second.

Steam Plant.—There is an auxiliary steam plant in Hartford itself, consisting of two compound condensing Corliss engines having a combined capacity of 1,600 H.P. These engines supply the power to operate one 600-KW. alternator and one 400-KW. rotary transformer, the latter so arranged that it can be connected with engines and operated as a direct or as an alternating current generator. The type is known in America as a "driven rotary." This rotary machine is worked as a generator whenever, owing to low water or repairs on the transmission line, the supply of alternating current is insufficient for the alternating current load and all the rotary transformers.

Parallel Running.—The three generating units—two operated by water and one by steam—have been continuously run in parallel during the last three years, and no difficulty whatsoever has been found, although the two sets of plant are of course 11 miles apart.

ROTARY TRANSFORMERS.

Three rotary transformers supply direct current to the three-wire direct-current system. One, mentioned above, has a capacity of 400 KW., and is located at the steam plant. Two others have a capacity of 250 KW. each, and are located in a battery sub-station, which is situated in the heart of the business section of the city, and about three-quarters of a mile from the steam plant.

Speeding Up.—Two of the rotaries are started and brought into synchronism by induction motors built on their shafts; the third is speeded up as a direct current motor, the current necessary for this being supplied from the accumulators.

Alteration of Voltage.—The machines are so designed that, by cutting in or out turns of the primary of the static transformers the voltage on the continuous current side may be varied between 230 and 360 volts. This wide range of voltage is necessitated by the fact that the rotaries are at times run directly on the line, and at other times used in charging the battery. The rotary transformers are two-wire, and simply supply the current to the outside wires of the three-wire system, the neutral wire being connected with the middle point of the secondaries of the two static transformers. This point being always midway as regards electric pressure between the two terminals of the rotary transformer.

Treatment of Carbon Brushes.—When first started there was considerable sparking at the commutator. It was found that very soft carbon brushes gave the best results, but without special treatment the sparking, although diminished, was still excessive. The following method of treating the brushes was found effective. The carbon brushes are first raised to a red heat, and then plunged in ordinary lubricating oil and allowed to cool.

Pumping of the Rotaries.—At the outset considerable difficulty was met with in preventing pumping when the engines were supplying power to the system, the pumping being traced to the variation in the angular speed of the engines. It was found that the tendency could be checked by varying the field excitation of the rotary transformers, or by temporarily throwing a portion of the load on to the storage battery. The 400 KW. rotary transformer, when tested by itself, proved to be free from any tendency to pump, either when operated from the steam plant, or from the water-power. When, however, it was thrown on to the line with the two other rotaries, they immediately began pumping, and it was found impossible to run the three machines together. The pumping in a rotary system seems to be cumulative; it is very easy to stop it if the proper remedy is applied as soon as the tendency is noticed, but if allowed to go on, it quickly gets beyond control. The impossibility of running the three rotaries together necessitated some cure, and this was found in attaching copper strips to the pole-pieces of the machine.

SYSTEMS OF DISTRIBUTION.

Two systems of distribution are used:—(1.) In the central portion of the city distribution is on the three-wire, 220-volt, direct current system. The feeders are lead-covered cables, drawn in cement lined ducts, and the distribution partly by Edison tubes and partly by lead-covered cables drawn in ducts. (2.) Outside the central portion of the city the feeders are supplied with two-phase alternating current at 2,400 volts pressure, and the distribution is on the three-wire, 220-volt, system, supplied from 10 or 20 KW. transformers. This service is partly underground and partly overhead.

Continuous Current Motors.—The direct-current system of distribution was adopted for the central portion of the city, as being the only one on which all kinds of service could be given from the same wires, especially if those wires were placed underground. In this section of the city a large number of motors are being frequently stopped and started, and it was considered that induction motors operated under these conditions would seriously interfere with the lighting service.

Induction Motors.—In certain sections of the city where the motors are in continuous use—for example, when they are used for running machinery in factories, and consequently are only started twice a day, there is no difficulty in operating induction motors and lights from the same system of mains.

Arc Lighting.—The arc lamps are all of the enclosed type, some being operated by direct current from the three-wire network, and the others worked in series from constant current alternating transformers. About 400 watts are supplied to each alternating current lamp, the transformers being operated from sub-stations. The inspector of the district turns the lights on and off, and visits the transformer house once only during the night. The transformers were practically automatic. They were made of two stationary coils and two movable coils, balanced on knife edges. The only motion is at the knife edge when the transformer is started and stopped.

ACCUMULATORS.

The storage battery has a capacity of 2,500 H.P.-hours at a five-hour rate of discharge. All three rotaries and the battery supply currents to the same three-wire direct-current system, the battery being at all times kept on the line for the purpose of regulation, and to meet any emergency call for extra power.

Maintenance Guarantee.—The battery was bought under a five-year guarantee, which has since been renewed for five additional years. The renewals have not been in excess of what was expected, and no investment of the company has been considered more satisfactory than the battery. Whenever any plate or number of plates have lost one-third of the original capacity, they are replaced by new ones; in this way the battery capacity is never less than 90 per cent. of its original amount.

Advantage of Combining Rotaries and Cells.—The advantages of the rotary transformer and battery system to the Hartford Company have been very great, for they have been able to use a great quantity of water-power that would otherwise have gone to waste. This has been utilised at the peak of the load at the time when power is most valuable. The total output of the water-power during the past year was over 90 per cent. of the possible output.

When operating by steam the engines have been run at an economical load, the advantages of the storage battery being nearly, if not quite, as great in connection with the operation of the steam plant as of the water plant. The regulation of the system is much better with the battery than it could possibly be without it, and the service is much more reliable. The interlocking of the battery with the alternating current by means of the rotary transformers makes the battery act as a regulator on the alternating current system as well as on the direct. During the day time on Sundays the entire load, both direct and alternating, can be carried by the storage battery. The battery has frequently been allowed to feed the alternating system through the rotaries. The transformer and battery station is operated by three men—the superintendent (an expert in the care of batteries) and two switchboard attendants.

It will be seen from the above that Prof. Robb is most enthusiastic as to the value of a storage battery in connection with electric lighting. It is a curious thing that the American engineers should be only just recognising that, for regulation, and to carry over the peak of the load, there is nothing to equal the use of accumulators. The guarantee of 90 per cent. for five years is a particularly good one, and shows that the American accumulator manufacturers are more enterprising than the British firms.

The method of varying the voltage on the continuous current side of the rotary by cutting in and out coils of the static alternating current transformers is interesting; if for nothing else, that it shows that the subsidiary booster is not an absolute necessity for charging cells in large stations. The writer thinks, all the same, that the booster has come to stay.

If the method of quenching carbon in lubricating oil does all that is claimed in the way of stopping vicious sparking, it ranks as an important discovery. In any case it is easily tried, and the writer trusts some engineers-in-charge will write saying whether they find the method beneficial on English machines.

The question of the pumping of rotary converters brings forward an important question for engineers on this side, as there are very few places in England where the even turning of a water-power plant is obtainable. It is true that we have the three-crank high speed engine, and if pumping does occur, the method employed at Hartford can be used. It is just a question, however, whether it would not be better to fight shy of the rotary converter altogether, and employ instead a self-starting induction motor, coupled to one or two ordinary multipolar machines, as has been advised by the engineers connected with the Blackheath and Greenwich Company. Unless some method of greatly increasing the speed is adopted, as, for example, the writer's suggestion for running transformers vertically, the number of poles of the rotary converter must always be very much out of proportion to the output. If a draughtsman were to set to work deliberately to design a very bad continuous current multipolar machine, he would make it with three or four times as many poles as it need have, and place a set of brushes at each pole. Well, this is exactly what he has to do in getting out a rotary converter, because the number of poles is governed entirely by the speed and the frequency, and the armature must of necessity be parallel wound to get the proper connections to the slip rings. For power work only, there is something to be said for the rotary, because then the frequency may be low, say, 25 or even less, and the number of poles so kept within bounds. For various reasons, however, 50 cycles per second is more likely to be used in this country.

The neutralising of the armature reactions by having continuous current and multiphase alternating currents circling round one armature core saves something in material (just as a single core continuous current transformer is cheaper than if two machines are simply bolted together), but it must be remembered that the rotary converter has to be brought up to synchronism either by a separate self-starting motor or else with current from the continuous current side. This latter method presupposes that there is continuous current to draw upon, which, of course, may not always be the case.

Assuming that 250 KW. have to be dealt with, and that the live current is two-phase alternating current at, say, 3,500 volts and 50 periods per second; also that the lighting is from a three-wire continuous current network, with 440 volts across the outers, then a comparison of the two methods stands somewhat as follows:—

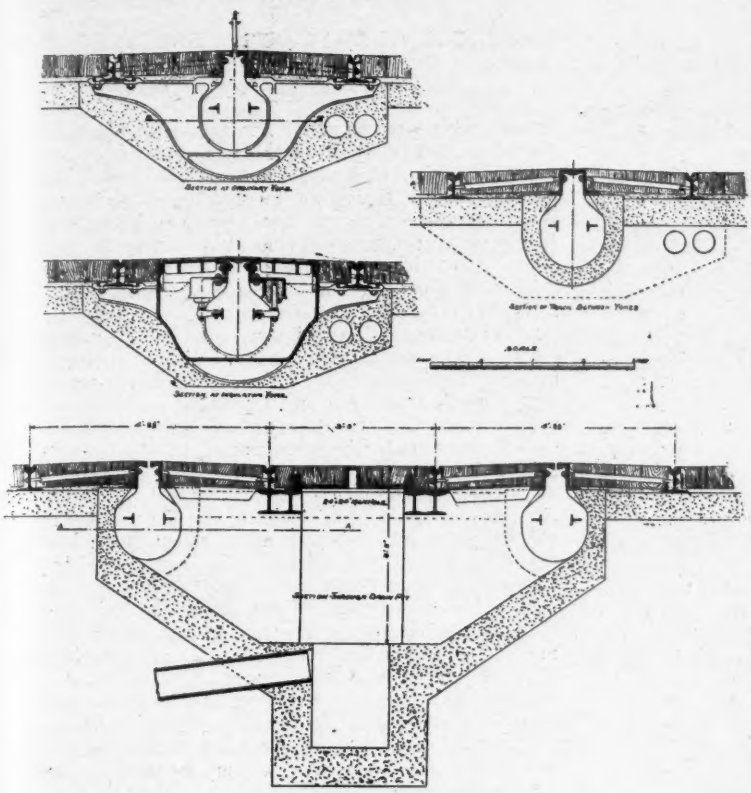
Rotary converter (running synchronously).	Self-starting induction motor, coupled to two ordinary multipolar dynamos.
Two static alternating current transformers, one in each phase.	None required, the full voltage being taken straight to the induction motor.
Four heavy low tension cables from the transformers to the slip rings of rotary.	None required.
Rotary running at, say, 500 revolutions, will have 12 poles. As armature must be parallel wound, there will be 12 sets of brushes to care for.	Dynamos built in the ordinary way on the most efficient lines. With series-wound armature there would be only two sets of brushes per machine.
To get the machine into synchronism, a small self-starting motor is required; or else switch-gear, to enable it to be speeded by working the continuous side temporarily as a motor.	The combination is always self-starting by means of auto-transformer. There is thus no need for special switch-gear on the continuous current side.
Voltage 460 volts across outers, with middle wire brought back to middle point of secondaries of the two static transformers. No regulation possible on each side of middle wire.	The voltage on each commutator, say, 230, the middle wire connected up in the usual way. Wide variation of voltage on each side by merely regulating field current.
For charging cells the voltage is varied by cutting in and out turns of the primary windings of the static transformers requiring special switch gear.	For charging cells the voltage may be temporarily raised by strengthening the fields of the dynamos, or if preferred a booster can be used.

The rotary converter takes up less floor space, but there is very little, if any, difference in price. Something may be saved in the second case by using a two-commutator dynamo instead of two separate machines, or a single commutator machine feeding direct on the outers may, of course, be employed.

THE LONDON UNITED ELECTRIC TRAMS.

THE London United Tramways Company has favoured us with drawings relating to its electrical lines within the County of London. The details of the scheme and the equipment were given in an article in our issue of July 7th. The line from Acton to Shepherd's Bush,

and from Shepherd's Bush to Young's Corner, at the western boundary of Hammersmith, will be electrically equipped on the overhead trolley system, and will connect with the Kew and Hounslow line at Young's Corner, so that the overhead trolley system will extend from Acton by way of Shepherd's Bush to Hounslow.



London United Conduit.

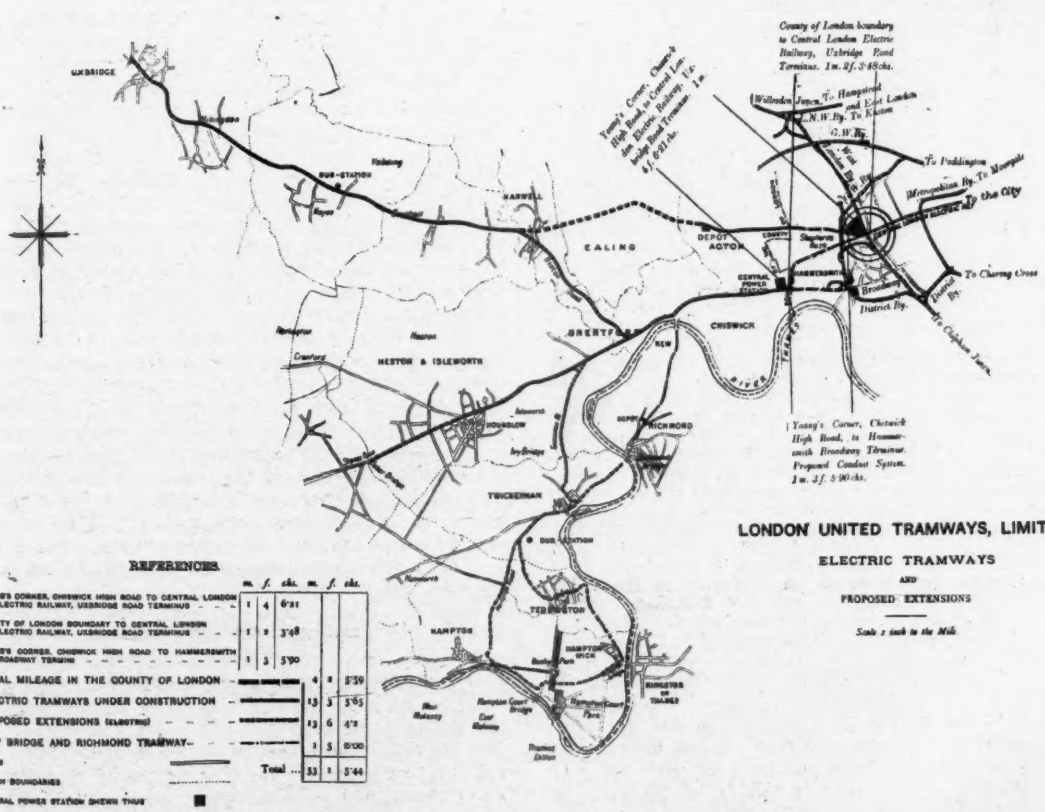
The proposed conduit system as shown on the drawings, which we reproduce, is for that portion of the company's lines between Young's Corner and Hammersmith Broadway, as required by the London County Council, a distance of about 1 mile. The roadway will be supported on yokes spaced 5 feet apart, bedded on Portland cement concrete; the depth of excavation required will be 3 feet from the upper surface of roadway, and there will be a slot $\frac{3}{4}$ inch wide in the centre of each line of track. Hand-holes with covers will be placed every 15 feet, and manholes connected with the sewers for draining the conduit will be provided at intervals of 150 feet.

In view of the importance of this system of the London United Tramways, and the great interest which is being taken therein, we reproduce a map showing the districts to be served by the several sections, with the extensions proposed up to June, 1899.

Mr. J. Clifton Robinson is the engineer to the company, Mr. H. F. Parshall being the consulting engineer.

THE NATIONAL PHYSICAL LABORATORY.

The definite initiation of this important step in the progress of scientific engineering in England has now taken place. We reviewed the proposal in its general aspect last year, when the stage had been reached of a consensus among the different authorities concerned as to the practical mode of carrying it out. At that time the committee appointed for the purpose had devised a scheme the Treasury was likely to accept, and now Parliament has voted



REFERENCES.

	m.	f.	ch.	m.	f.	ch.
YOUNG'S CORNER, CHISWICK HIGH ROAD TO CENTRAL LONDON ELECTRIC RAILWAY, UXBRIDGE ROAD TERMINUS	1	4	6·21			
COUNTY OF LONDON BOUNDARY TO CENTRAL LONDON ELECTRIC RAILWAY, UXBRIDGE ROAD TERMINUS	1	3	3·48			
YOUNG'S CORNER, CHISWICK HIGH ROAD TO HAMMERSMITH BROADWAY TERMINI	1	3	5·90			
TOTAL MILEAGE IN THE COUNTY OF LONDON				4	3	5·59
ELECTRIC TRAMWAYS UNDER CONSTRUCTION				13	3	3·65
PROPOSED EXTENSIONS (ELECTRIC)				13	6	4·2
KEW BRIDGE AND RICHMOND TRAMWAY				1	5	0·00
			Total ...	33	1	5·44

ROADS
PARISH BOUNDARIES
CENTRAL POWER STATION SHEWN THUS ■
SUB-STATIONS •

LONDON UNITED TRAMWAYS, LIMITED.

ELECTRIC TRAMWAYS AND PROPOSED EXTENSIONS

Scale 2 inch to the Mile.

the money, and the governing body of the new institution has been appointed for the purpose. The *Times* of August 15th gave some details of the arrangements that have been made.

The laboratory is to be an extension of the Kew Observatory in the Old Deer Park at Richmond, and for the purpose of the extension the Treasury is to find £12,000.

The annual income of the new institution will consist of £458, the endowment of the old laboratory from the Gassiot trust, of £4,000 from the Treasury, and of the fees received for the verification of instruments. These last have amounted annually to £2,700, and should produce a considerably larger income in the future. Thus the institution begins with an income of upwards of £7,000 a year.

The ultimate control is in the hands of the Royal Society, the immediate control in the hands of an executive committee and a general board, any alteration in the constitution of the two latter bodies requiring the consent of the Treasury. This is, of course, the usual arrangement of public institutions in England, and is immediately modelled upon the constitution of the Greenwich Observatory. An executive authority, a visiting authority, and an authority capable of altering statutes seem to combine in a convenient way the rigidity of a continuous rule and policy with the flexibility necessary for changing circumstances. Its success usually requires that the executive should be fairly susceptible of external influence, and the constitution in this case, so far as can be judged from the information before us, promises well. The executive committee will ultimately consist of 17 members, of whom five are official; viz., the chairman of the committee, the president, treasurer, and one secretary of the Royal Society, and the permanent secretary of the Board of Trade. Of the other 12, six are appointed, one by each of the principal technical societies; viz., the Civil, Mechanical, and Electrical Engineers, the Naval Architects, and the Society of Chemical Industry. How the other six are to be appointed is not mentioned. In the first instance, the existing Kew Observatory committee will be represented by six members, but on the expiry of their term of office their places will not be filled up.

This executive committee will report annually to the general board, a relatively large body, and will submit to them its scheme of work for the ensuing year. Six members of the general board will be nominated by the six technical societies beyond the six appointed to the executive council, and it is evidently anticipated that this strong representation of the commercial interests will keep the body fairly in touch with the practical requirements of the country.

The council of the Royal Society has appointed Mr. R. J. Glazebrook, the principal of University College, Liverpool, to be director of the National Physical Laboratory, and the following are the members of the executive committee:—

Lord Lister, P.R.S., Lord Raleigh (chairman), Mr. A. B. Kempe, Treas. R.S., Prof. A. W. Rücker, Sec. R.S., and Sir Courtenay Boyle (*ex officio*), Capt. W. de W. Abney, Sir N. Barnaby, Mr. G. Beilby, Sir E. H. Carbutt, Capt. E. W. Creak, R.N., Prof. R. B. Clifton, Prof. G. C. Foster, Mr. F. Galton, Prof. O. J. Lodge, Sir A. Noble, Prof. J. Perry, Sir W. Roberts-Austen, Prof. A. Schuster, Mr. A. Siemens, Gen. Sir R. Strachey, Prof. J. J. Thomson, Dr. T. E. Thorpe, and Sir J. Wolfe Barry.

In addition to the above, the following are also members of the general board:—Sir M. Foster, Sec. R.S. (*ex officio*), Sir F. A. Abel, Prof. W. G. Adams, Prof. W. E. Ayrton, Mr. H. Bell, Mr. A. Buchan, Mr. R. E. Crompton, Prof. G. F. Fitzgerald, Prof. J. Joly, Lord Kelvin, Mr. J. T. Milton, Sir W. H. Preece, Mr. W. F. Reid, the Earl of Rosse, Dr. R. H. Scott, Mr. W. N. Shaw, Mr. C. E. Stromeyer, Admiral Sir W. Wharton, and Sir W. H. White.

The following have also been requested to serve on one or other of the sub-committees above referred to:—Messrs. E. D. Archibald, C. V. Boys, Prof. H. L. Callendar, Messrs. Forbes, Carpenter, W. H. M. Christie, J. H. Dallmeyer, Prof. J. A. Ewing, Mr. S. Z. de Ferranti, Prof. J. A. Fleming, Messrs. R. E. Froude, E. H. Griffiths, J. Mansergh, T. Matthews, W. H. Maw, Dr. L. Mond, Hon. C. A. Parsons, Prof. A. W. Reinold, Captain H. R. Sankey, Messrs. J. Swinburne, G. J. Symons, H. A. Taylor, Prof. S. P. Thompson, Messrs. J. I. Thornycroft, C. H. Wordingham, and A. F. Yarrow.

Mr. Glazebrook is to enter office at the beginning of the new year, and a definite scheme of work is to be arranged during the autumn. The announcement of this will be of great interest, as it seems certain that some of the electrical questions must be among those to be dealt with first. Of all the appointments Mr. Glazebrook's is, of course, by far the most important, and we hope he will obtain a reputation for energetic administration and initiative not inferior to that which he now enjoys for scholarly exactness. He has hitherto come into contact with electrical engineers principally through his official comparisons of standards of resistance at the Cavendish laboratory at Cambridge.

SOME CONSIDERATIONS AFFECTING GAS ENGINES.

In connection with our recent remarks on the Westinghouse gas engine, it may not be amiss to go further into the subject with a view to establishing some fixed idea as to the working of gas engines in the production of electricity. When the gas engine was first introduced it was wasteful. It is wasteful still, but it was more especially so in its early days. Almost the whole of the endeavours to improve gas engines are along the line of economy. Something of this is due to the fact that gas engines were more essentially the small manufacturers' motive power, and the only available source of gas was the town main. Economy of gas was more valuable than regular turning. It mattered very little that a chaff-cutter or a small printing press had a very variable speed, and the gas engine, as developed in Europe, has almost invariably been constructed on the hit-and-miss principle of governing in order that the superior economy of this principle of action might be secured. Illuminating gas has been so costly in America, that the progress of the gas engine has been very slow up to recent dates; but now that it has been proved capable of being constructed in large sizes, the gas engine has appeared to Americans as eminently suitable for use with their cheap natural gas and with producer gas, and we cannot but think that in abandoning the more economical principle of hit-and-miss governing in favour of more wasteful moderated charges, American constructors have followed correct lines. Unless a gas engine is worked up to its maximum load, it cannot be other than irregular in action under the hit-and-miss principle, and so far irregular as to unfit it, in the opinion of some, for direct connection to lighting dynamos.

The Westinghouse engine, when using London gas at full load, will generate 40 KW.-hours on a consumption of 1,000 cubic feet of gas. At 2s. 6d. per 1,000 feet, this is equal to ¾d. per KW.-hour, or 1½d. including attendance, maintenance and depreciation, which compares favourably with the prevailing price of 4d. to 6d. per unit.

But 2s. 6d. is a very high price to pay for gas, and far away in excess of the cost of an equivalent capacity of energy in the form of producer gas, and there can be no doubt that a H.P.-hour can be produced by means of gas engines with not more than 1 lb. of fuel. Under these circumstances, it may well be doubted whether it is worth while to neglect the gas engine simply because it works to best advantage when governing on the system of moderated charges. Obviously, under any system of governing, the gas engine will be most economical when it is working up to its maximum effort. When working near to its maximum capacity, it cannot matter much whether one or the other system of governing is practised, for it is only at reduced load that the difference of the two systems is felt. There is no difference in the engines to account for any difference of economy—it is simply a question of the gas mixture. In the Westinghouse engine, the less economical system has been adopted, a system so far adopted by few others, and we believe by no maker of large engines. If the purchaser of a gas engine can lay down a gas plant and produce power with the requisite steadiness for less cost than he can produce the same power by means of steam engines, we are inclined to think he will adopt such gas plant, even if he is told that he might purchase other gas plant, say, 20 per cent. more economical, but not productive of equal regularity of turning. The large power user must have a certain steadiness of turning effort. This is his *sine quâ non*. Give him this and he will use that agent which gives it to him for least money. Offer him less regular turning at half the cost, and if he be a cotton spinner, he must decline the offer because he cannot produce an even yarn, and will also make much waste; if he be an electrician, he will have to decline again, because irregular turning shows itself in an unsteady light; if he be a water-

works engineer, he will accept because a few per cent. matters nothing in pumping, and it is worth while to save even 5 per cent. of fuel and accept a speed variation of, perhaps, double as much in doing so. It is claimed by the Westinghouse Company that the cost of power produced by gas engines fed by gas from a central gasworks, the engines being placed where now the rotary transformers are placed, should not exceed 50 per cent. of the cost of power produced by steam plant with high tension and step-down transformation. The suggestion is worth considering, but it should not be overlooked that if producer gas be intended, its volume per unit of capacity is very considerable, and a large gas engine will demand a gas main of correspondingly large capacity.

Natural gas will be consumed in a Westinghouse engine at the rate of 10½ to 12 cubic feet per H.P.-hour. It must be remembered that this gas is very rich; it has a calorific value of 1,000 B.T.U. per cubic foot; it is thus about tenfold richer than producer gas. Taking the case of an engine of 1,000 H.P., the consumption being 10 cubic feet of natural gas per H.P.-hour, we have no less than 100,000 cubic feet of producer gas to be conveyed to the engine. For argument, we will assume a velocity of flow of 100 feet per second. The engine is using 1,666 cubic feet per minute, or, say, 28 feet per second, so that the pipe area must be nearly 36 square inches. Thus each 1,000-H.P. engine would require a supply pipe 6 inches square, and for gas at low pressure square pipes would be quite suitable. According to Unwin, a desirable initial velocity of flow is 45 feet per second, at which velocity an initial pressure of 16·71 lbs. per square inch will transmit 31,815 cubic feet of gas per hour through a 6-inch round pipe 5,000 feet long, a rate less than half we have assumed above. Obviously, therefore, the question of gas transmission is of some importance, though the laying of a 6-inch pipe is not expensive, and 500 H.P., which could be carried by it, according to Unwin, is no small power at a sub-station. Considering the cheapness of gas-power under modern conditions there appears every reason to anticipate a considerable use of gas engines in the near future, if only gas engine makers will give an engine of sufficient regularity of turning effort as the Westinghouse Company now propose to do, and as any of our English makers are at full liberty to do if they will accept the system. Is it not better to use 1 lb. of coal by gas power than 2 lbs. by steam power? Yet the latter is adhered to, because when using its 1 lb. of coal the gas engine is not at its best. It is clear that if economy is specially desirable the gas engine must be worked as closely to its maximum duty as is consistent with certainty of action. If hit-and-miss governing be retained for its economy then must it be considered—we refer here to power purposes only, and more particularly to traction work—whether the voltage variation, which goes with economy of gas, can be permitted. The question is very much one for compromise between the best economy, steady turning and voltage, and fly-wheel weight.

THE NIAGARA SUSPENSION BRIDGE.

The new electric railway suspension bridge of the Lewiston Connecting Bridge Company and the Queenston Heights Bridge Company, now controlled by the International Traction Company, was formally opened to the public on Friday, July 21st, in the presence of a notable assemblage of guests. Invitations of an elaborate character were issued by Hon. W. Caryl Ely, president of the International Traction Company, and these had the Stars and Stripes and the Union Jack in colours at the top.

Electric cars are now running across the bridge, but, says our correspondent, the belt line, of which the new structure is to be a link, has not yet been inaugurated, owing to the lack of connection on the New York side with the upper steel arch. This connection will be made as soon as the Commissioners of the New York State reservation grant the necessary right. The new bridge has a cable span of 1,040 feet, and a suspended span of 800 feet. It is 25 feet wide, and a single track for electric cars is laid through the centre of the floor. It is expected that all the cars of the Niagara region will be fitted so that they can make the round trip. On the day of the opening the structure was beautifully decorated from end to end, forming a magnificent scene. The American and British flags waved at both ends, and both were cheered to the echo.

The Niagara Suspension Bridge.

WHAT'S A' THE STEER, KIMMER?

So far as we can gather from the local press and other sources, the Glasgow hubbub is, as the *Evening Times* dubs it, a case of "first she would, and then she wouldn't."

If our information is correct, the electrical adviser to the Tramway Committee was commissioned to draw up a general specification, so that all engine makers would be free to tender on their own standards, but for the purpose of assisting many British firms, the leading dimensions of the principal parts were set forth, qualified by the statement that these dimensions were not insisted upon.

Messrs. E. P. Allis and one English firm tendered to these

dimensions, but the other makers varied greatly therefrom and from one another.

We understand that the E. P. Allis Company were considered to have sent in the best tender, both as to design, weight, guarantees as to efficiency, &c., and delivery, with one exception to this latter point. Messrs. D. Stewart & Co. could have delivered in the quickest time, but as their tender was only for about half the sum quoted by the Allis people, there was probably some misconception on the part of these contractors as to the nature of the specification.

We believe Messrs. Musgrave & Sons were well in the running for design and efficiency, but required 2½ years to complete, as against the 20 months of Allis.

Messrs. Stewart have apparently taken some decided steps over the matter, and the upshot of the whole thing is, that the Council has decided that a new specification be issued.

This seems hardly just to makers who have already tendered on a clear understanding of the requirements, since the Glasgow firm now knows what those contractors, whose estimates were in order, will again tender upon, and also their prices, and nobody seems to have thought that a similar course should be adopted with regard to the generators as well.

En passant, we may say that a good illustration of the Allis type of engine was given in the ELECTRICAL REVIEW for March 4th, 1898, but we have but little information on this side as to what renders American engines so superior to those of English manufacture for traction work.

During the discussion which followed the reading of Mr. Cuningham's recent paper on "Mechanical Traction by Electricity" before the Institution of Civil Engineers, considerable divergence of opinion was manifested as to the relative advantages of high speed and low speed engines for traction work, some of those taking part in the discussion manifesting a preference for low speed, others for high speed, and a third section stating that they used either type indifferently.

For our own part, we see no reason why the high speed of revolution which has become such a leading feature in English lighting practice should not be equally useful in traction work.

In the first place, the quick revolution engine is invariably a vertical, or, rather, inverted engine, whilst the slow speed engine, or, at any rate, the slow speed engine which has been sent over here from America is as invariably a horizontal one.

We are sure that there is no necessity for us to dilate on the many points of advantage which the vertical engine has over the horizontal type. It is quite sufficient to remind our readers that 30 years ago horizontal engines were common in marine practice, and that to-day the vertical type is universal, and that, moreover, in central station practice the same tendency has been manifested. We could instance numerous electric light stations which have been started with slow speed horizontals, but continued with vertical engines at more or less high speed of revolutions.

There is too much tendency on the part of those who have not the necessary ability to think for themselves to accept the view that the American practice is bound to be right because of the extensive experience they have had in matters connected with electric traction on the other side of the Atlantic. But is this necessarily so? We may remind our readers that in the States they were going on with belt drive and even using countershafts long after direct coupling had been recognised as the best practice and become of almost universal application here. We have no doubt but that in the States, as here, the vertical type of engine will become standard for traction work, and that the speed of revolution will be materially increased in the near future.

At present we take it that the type of engine which is being offered by the American builders as the best for traction work is either a tandem compound horizontal single-crank, with the generator at the side, as at Glasgow and Bristol, or a compound side-by-side double-crank, with the generator between, as for the Central London Railway. How does such an engine compare with those previously described at the Waterloo and City station, for instance, as representing English practice?

We have already pointed out the great advantage the vertical quick revolution engine offers in the way of space occupied. No doubt the experience at some of the lighting stations we know of will yet be repeated in connection with some of the power stations for traction work under conditions somewhat as follows:—

The necessity for additional plant is forcing itself upon the attention of the engineer, his station has been built in, and land for extension is unobtainable; it is necessary, therefore, to make the most of such area as he has left, or otherwise to incur the very considerable outlay involved in building an additional station elsewhere. Under these circumstances, although he may be prepossessed in favour of low speed engines, he succumbs to the logic of facts, and goes in for high speed sets.

We know of at least one important traction station at the present time where it is actually in contemplation to fill up the spaces between the existing low speed sets with a high speed set of three times the power of those originally installed.

Of course, with the reduced ground area, there is the smaller building to cover it, and lighter travelling crane of less span required. The reciprocating parts of the quick revolution sets are so much less massive and cumbersome than the similar parts of the low speed engine, parts which, in the quick revolution engine, can be easily handled by one man; in the other engine they require a crane and a man to work it before they can be moved. Compare, for instance, the size of the L.P. cylinder at the Waterloo and City station with that at the Glasgow station. Although the Glasgow engine is of approximately the same power the L.P. cylinder there is 24 diameter × 24 stroke against 14 diameter and 9 stroke at the Waterloo and City station. The disparity is startling, and when it is considered further what such a large piston involves in the way of load on the bearings and the much greater impact there will be on the crank pins, particularly if a load is suddenly thrown on when near the end of the stroke, it is clear that all the advantages do not lie with the low speed engine, bearing in mind that the piston speed of the so-called low speed engine may be, and often is, higher than that of its quick revolution rival, and that the impact depends on the piston speed and not on the speed of revolution.

Following on the large L.P. piston, it is not surprising to find that the American engine is distinguished by a large fly-wheel—in fact, for such an engine a large fly-wheel is a necessity if anything like even turning is to be had.

The fly-wheel performs a double function—first, to maintain a uniform angular velocity during each revolution; secondly, to serve as a reservoir of energy to meet the momentary variations in the load characteristic of the traction load diagram.

So far as the first of these functions is concerned, the Waterloo and City engine has, of course, an enormous advantage. A three-crank engine with a complete engine on each crank is the nearest possible approach to absolutely even turning, short of a steam turbine.

The American engine, with its single crank, is the reverse of this. Careful calculations we have made have shown that to attain the same degree of even turning with the Glasgow engine, as with the Waterloo and City set, the fly-wheel for engines of the same power would need to be 16 times as heavy.

The large fly-wheel is, of course, useful as a store of energy, but when the enormous dimensions and weights of the fly-wheels on some of the American engines are considered, one is constrained to consider whether the same result could not be obtained with something less. Take, for instance, the fly-wheels of the engines at the Brooklyn power station, particulars of which will be found in the *Proceedings of the Institution of Civil Engineers* for 1895-6, these being communicated during the discussion following Mr. Cuningham's paper on the Montreal Street Tramways. Fly-wheels 24 feet in diameter, and weighing 65 tons, for engines of 2,000 H.P., and working in conjunction with armatures 10 feet in diameter, and weighing 27 tons, are of truly Herculean proportions.

We estimate from the particulars given that the kinetic energy will not fall very short of 4½ foot-tons per E.H.P., the similar figure for the Waterloo and City station being 2½ foot-tons, and the perfection of governing attained shows that even this may be reduced for the future.

We have always understood that the close regulation on which American engine builders plume themselves was due

to the perfection of their automatic expansion governors, but it would seem that the immense fly-wheel effects they use have more to do with it than the automatic expansion.

Unfortunately, too, these large fly-wheels have an awkward knack of going to pieces when least expected, with results worse than a boiler explosion; in fact, one might almost as well have a powder magazine in the engine room as some of the American engines, from the sensational narratives which are received from the other side from time to time.

We have seen some wonderful devices designed to meet this tendency of the fly-wheels to distribute themselves over the neighbourhood, but it does not seem to occur to our cousins across the water to alter the design of their engines, and so avoid the use of such monstrosities altogether.

The English type of engine for traction purposes is generally self-lubricating, which is a decided point of advantage; there is no running about with oil cans, careful adjustment of oil syphons, lynx-eyed supervision of numerous oil pipes to see that every bearing is getting its proper quantity of oil, and not too much of it either, no feeling the bearings at frequent intervals as with the low speed engines. This naturally results in a reduced cost for attendance. It is not unusual to enter a quick revolution station and find one man in charge of three or four 500-H.P. engines, but no one would think of running low speed sets of the same power with less than one man to each.

With respect to oil consumption, this again is in favour of the quick revolution type. The same oil is used over and over again, with the result that the consumption is reduced to a figure which is surprisingly low, and not only does the low speed or semi-high speed open engine use a great deal more oil, but the oil is thrown about the engine room with consequent discomfort and mess. Specifications for open engines used to read "Engines of the enclosed type will also be considered." It is now common to find a paragraph reading as follows:—"The engines must be of an enclosed or cased-in pattern so as to be clean running and to avoid throwing oil about the engine room."

Returning to Glasgow and its troubles, we may now consider what is likely to be the impression amongst engineers throughout the kingdom, since American firms have also carried off (if the Tramway Committee's recommendation is approved) three-phase generators, auxiliary generators, exciter generators, transformers and rotary converters, and boosters, to the tune of well over £100,000.

A consulting engineer is appointed to advise the Corporation at a fee not exceeding £10,000, whatever the capital expenditure. Presumably the object in view in making such an appointment is the saving of money by securing the best advice, so as to avoid, on the one hand, the risk of getting the work into the hands of incompetent contractors, who would land the Corporation in failure, and, on the other, to prevent paying through the nose to competent firms. If, however, the consulting engineer soars away over the heads of eminent engine builders, such as Hick, Hargreaves and Co., and Messrs. Musgrave & Sons, not to mention others, and recommends a higher American offer because the trans-Atlantic firm knows all about the work, having built so many similar engines before, does it not seem that money might have been saved by simply going in the first instance to a few of the best known American makers and placing oneself in their hands, without engaging an expensive consulting engineer at all?

The tramway department possesses a keen, shrewd, and able business man in Mr. John Young as general manager, an excellent and thoroughly practical engineer in Mr. Clark, and a perfectly competent and experienced electrical engineer in Mr. Le Rossignol.

These gentlemen were surely able to put the requirements of the department in such form that competitive offers could have been obtained from those firms which are known to have carried out such work before, and they would have had no difficulty in deciding to order all the dynamos from the British Thomson-Houston Company, the rotary converters and transformers from the Westinghouse Company, and the main engines from E. P. Allis & Co. The prices, probably, would not have been more than at present, and the consulting fee would have been saved.

We do not assert that this would have been the wisest course to adopt, but we do think that after employing a gentleman of such eminence as Mr. Parshall to draw up a specification, English engineers should have had no difficulty in complying with it; that this was by no means the case is evidenced by the letter of Messrs. Hick, Hargreaves & Co., which we publish on another page, although the E. P. Allis Co. contends that it contained nothing but the results of the best accepted practice. If everything had been plain sailing, and the American offers turned out lower with more speedy delivery, there would have been an end of the matter, but if the estimates of competent English builders are below those of the Americans, how is it that the expert is still obliged to advise the acceptance of the American offer at a much higher price?

What, in the eyes of the impartial observer, seems to have been done—and this is borne out by the Glasgow *Evening Times*—was to issue a specification with very little more than a general outline in it, and then a list of suggestions of what would be considered satisfactory, this list, however, not forming part of the specification, as there was no desire to hamper engine builders by tying them down to any particular pattern.

Quoting from the *Evening Times*, "Mr. Parshall, in his reports, pointed out that he had strongly hoped that some British engine maker could rise on this occasion and tender on an engine in all ways suited for electrical traction work. It was with the view to assist them in this direction that he gave dimensions and particulars in the specification. He should much prefer to be able to recommend the product of some first-class British firm, since he was alive to the feeling against engineers who recommended foreign-made apparatus. In the present case he had no alternative to recommending anything but the Allis engine. It was best for their purposes, the price was not unreasonable for what they proposed to supply, and this could be considered quite apart from the fact that they had greater experience than any other firm, and could supply what was required with absolute certainty, and without constructing anything that was new to them."

When the tenders were in, the process adopted seems to have been, judging from Mr. Paton's exhaustive comparative comments at the Council meeting, to take the Allis engine as the specification and judge all the others by it, condemning them in every detail wherein they differed from it.

A significant remark was that of Bailie King, who said that if anyone had given reasons for taking back the minute which was before the meeting, Bailie Paton himself had done so, when he stated that if Mr. Parshall drew out specifications for an engine, he could only draw one out for an engine such as the Allis people made.

We have tried to ventilate this very important subject, important alike to the English engineering industry and to the Corporation of Glasgow, with a mind free from bias, and we respect the sentiments of our evening contemporary which concluded its editorial comments with the following:—"If we must have the Corporation work done by purely British or purely Glasgow contractors, then the conditions of contract should be drawn out accordingly. That would be bad business, but it would certainly be more dignified than the system of inviting outsiders to tender and then searching for a loophole of escape. The city must above all things preserve its reputation for fair dealing."

One thing is quite certain—the Glasgow Corporation has perfect freedom to seek the best machinery in the market, and if, in the opinion of their expert, who, presumably, has an intimate knowledge of all and everything connected with the best electric traction practice, the plant is not forthcoming here, but is available and ready to hand in the States, he is within his rights in advising his clients to adopt a course which is based on the results of his own unique experience. If any blame attaches to anybody, surely it should rest from the beginning on the shoulders of the Tramway Committee.

We shall probably refer to this matter again in our next issue, when we hope to give our own opinion on the manner of drawing up the specification, which we have seen only since this article was written.

Presentation.—Mr. C. A. L. Prüsmann, who has left the Bradford electricity works, where he was assistant electrical engineer, to take up a chief engineership at Doncaster, was last Friday presented with a photograph of the members of the department, an illuminated address, and a travelling bag and dressing case, by the members of the staff at Bradford.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

16,094. "A watchman's electrical tell-tale system." A. Eckstein and H. J. Coates. Dated August 8th.

16,132. "Improvements in method of and means for inducing and controlling magnetic circuits." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated August 8th. (Complete.)

16,133. "Improvements in alternating electric current motors." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated August 8th. (Complete.)

16,140. "Electrical resistances and heating bodies composed of metallic oxides." V. I. Feeny. (Allgemeine Elektricitäts Gesellschaft, Germany.) Dated August 8th. (Complete.)

16,167. "Improvements in or relating to switches for electric traction systems." H. O. Joedicke. Dated August 8th. (Complete.)

16,175. "Improvements in and relating to electric batteries." C. Levetus. Dated August 9th.

16,191. "Safety guides for trolleys used in overhead electric traction." A. W. Murray. Dated August 9th.

16,198. "Improvements in and connected with multiple switchboards." H. Oppenheimer. (Actiengesellschaft, Mix & Genest, Germany.) Dated August 9th.

16,199. "Improvements in and connected with switches for high voltage." H. Oppenheimer. (Actiengesellschaft, Mix & Genest, Germany.) Dated August 9th.

16,200. "Improvements in and connected with lampholders." H. Oppenheimer. (Actiengesellschaft, Mix & Genest, Germany.) Dated August 9th.

16,210. "Improvements in the manufacture of thin tubes or sheets of copper or other metal by electro-deposition." S. O. Cowper-Coles. Dated August 9th.

16,215. "Improvements in electrolytic baths." W. Walker, jun., F. R. Wilkins, J. Lones, and J. Lones. Dated August 9th.

16,225. "Improvements in conduits for laying electric cables." W. H. Nichols and W. T. Henley's Telegraph Works Company, Limited. Dated August 9th.

16,247. "A new material adapted for electrical insulation and also for many purposes for which ebonite, wood, and such like materials are used." A. Smith. Dated August 9th. (Complete.)

16,250. "Manufacture of colouring matters and their reduction products by electrolysis." R. M. Salmer. Dated August 9th.

16,267. "Improvements in electrical apparatus for sorting articles according to one of their dimensions." W. H. Lock and J. J. Milner. Dated August 10th.

16,285. "Improvements in plugs for telephone switchboards." E. D. Pearmain. Dated August 10th.

16,290. "An apparatus for the temporary closing of an electric circuit-current by means of Herz's undulations." J. Levy. Dated August 10th. (Complete.)

16,293. "Improvements in the manufacture of leaden plates for secondary batteries or accumulators, and in moulds and tools to be used in such manufacture." P. J. Davies. Dated August 10th.

16,300. "Improvements in safety fuses for electric circuits." E. T. Goslin. Dated August 9th.

16,308. "An improved operating device for electric bells and house-telegraph signals." F. Schuchhardt. Dated August 10th. (Complete.)

16,311. "Improvements in or connected with dry core electrical cables." H. Savage and W. T. Henley's Telegraph Works Company, Limited. Dated August 10th.

16,330. "Improvements in switches for connecting electric machinery." W. F. Jones. Dated August 11th.

16,336. "An apparatus for controlling the supply of electricity." W. L. Hardman. Dated August 11th.

16,350. "A magnetic needle-threader." M. Molitar and F. Kern. Dated August 11th. (Complete.

16,352. "Improved system of telegraphy and transmission of currents of electricity." F. Bedell. Dated August 11th. (Complete.)

16,368. "Duplex electrical alarm." A. R. Warden and A. Hunter. Dated August 11th.

16,373. "Improvements in vibrating switches or contact breakers for induction coils, bells, and the like." J. Burns. Dated August 11th. (Complete.)

16,382. "Improvements in connection with spindles and the driving of the same by electricity.' J. G. Lorrain. (H. B. Sawyer and R. Robb, United States.) Dated August 11th.

16,387. "Improvements in brush-holders for electric machines." F. H. Short. Dated August 11th. (Complete.)

16,395. "A new and improved arrangement for controlling electric elevators." E. A. Wahlström. Dated August 11th.

16,410. "Improvements in electric arc lamps." A. Eckstein and A. E. Angold. Dated August 12th.

16,417. "Improvements relating to jointing electric cables." R. H. Hayne. Dated August 12th.

16,439. "Improvements in or relating to arc lamps." G. C. Dymond, of the firm of W. P. Thompson & Co. Dated August 12th. (Complete.)

16,444. "A method of receiving telegraph signals as displayed or photographed by magnetically deflected cathode rays." Siemens Bros. & Co., Ltd. (Siemens & Halske, Actiengesellschaft, Germany.) Dated August 12th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

12,714. "An improved insulating and carrying frame for accumulator electrodes." F. W. Schneider. Dated May 22nd, 1897. Relates to framework for insulating and supporting cylindrical or trough-shaped electrodes in vehicles and other places. It consists of perforated plates of hard rubber connected by bolts on which, between the plates, are fitted rubber sleeves. The bolts support the electrodes. 2 claims.

12,820. "Improvements in transforming continuous electric currents." A. Muller and H. Tudor. Dated May 24th, 1897. Relates to the transformation of continuous currents by means of secondary batteries. The batteries are divided into groups which are connected to the sections of a commutator, and an equalising battery is placed in shunt with the generator or translator. The conductors are connected to the brushes of a commutator driven by a motor. The secondary battery is divided into groups which are connected to the sections of the inner ring of the commutator. A high tension current is thus obtained in the conductors. To obtain a low tension current for the consumers, a similar arrangement of apparatus is employed, but the lamps, &c., take the place of the generator. To prevent sparking at the commutator, a separate contact-breaker is employed. It comprises a disc fitted with segments corresponding to the contacts of the commutator. Methods of arranging both batteries in groups to obtain any desired ratio of transformation are also described. 2 claims.

12,902. "Improvements in series parallel controllers for electric motors." P. V. McMahon. Dated May 25th, 1897. Consists of switching gear, of the kind known as series parallel controllers, for starting motors in series and placing them in parallel after a certain speed has been attained, as in the case of an electric locomotive or other electrically-propelled vehicle. An ordinary rheostat or starting switch, with contacts which are preferably circular, but may be rectilinear or of other convenient design, and a separate paralleling switch, with contacts mounted on the fixed insulating plate, are mounted on the same base and operated by the same handle. The brushes or the contact fingers of the paralleling switch are mounted on an insulating disc or arm, which is free of the handle of the rheostat switch, except during a certain portion of the movement of the latter towards each end of its throw when the projections engage with each other. It results that the change from parallel to series or *vice versâ* cannot be made without first putting in or out of circuit, as the case may be, the necessary resistances for preventing sparking. 2 claims.

12,942A. "Improvements in electrical ignition apparatus for explosion engines and for other purposes." C. M. Johnston. Dated May 25th, 1897. The sparking terminals in the cylinder of an explosion engine are connected with the secondary circuit of an induction coil. The primary circuit containing the condenser is excited by a battery, which is charged by a generator; it is broken and completed at the proper time by a switch. A large coil may be used without the condenser, or a large condenser without the coil. 3 claims.

12,945. "An improved electric arc lamp." F. Fasquet and J. W. Keys. Dated May 25th, 1897. Relates to arc lamps. A clockwork lamp, for continuous or alternating current at constant potential, is constructed as described. The upper carbon holder is attached to a long rod and the lower one to a short rod sliding in guide tubes. The rods are attached to the ends of a cord, which passes over two pulleys and under a pulley. The pulleys are carried by a lever at unequal distances from its fulcrum. The longer end of the lever supporting the lower carbon is drawn down by a spring separating the carbons when the lamp is not in use. The shorter end of the lever carries two cores within the two shunt coils of a fixed electro-magnet. The pulley turns on a stationary axis, and drives an oscillating balance when a pin on this is released by a notched plate on an arm of the lever by the action of the shunt magnet. The motion of the lever is limited by screws, and the tension of the spring is adjusted by a lever and screw. 1 claim.

14,810. "Improvements in electric motors for driving motor carriages, winches, and stationary machinery, also a portable motor for rotary hair and cleaning brushes for milling, drilling, and other purposes." H. W. Headland. Dated June 19th, 1897. Relates to electric motors for driving motor carriages, tramcars, winches, and stationary machinery; also, in a portable form, for drilling, milling, rock and blasting drills, rotary hair and cleaning brushes, dentists' tools and other purposes. The armature is fixed on its shaft, and the field magnets are carried by a casing running loosely on the shaft, and the shaft and casing are connected by bevel, skew, or worm gearing with one or more intermediate shafts which transmit the power. In a form shown, the armature shaft and field-magnet casing carry bevel-wheels which gear with bevel pinions on an intermediate shaft which by means of a worm may transmit the power to a motor-car axle. A second shaft and axle may be driven in a similar manner. The armature shafts and driven shafts are supported in ball bearings in a frame. This frame may be pivotally suspended from the underside of a motor-carriage frame. When employing worm gearing, worms of opposite pitch on the field-magnet hub and armature shaft gear with two parallel, which they drive in the same direction. The form of the supporting-frame may be variously modified. 6 claims.

14,923. "Improvements in alternate current motors." A. Soames. Dated June 19th, 1897. To facilitate the starting of alternating current motors, the field-magnet is provided with two sets of windings, one of which is adapted to produce a larger number of poles than the other. The former is employed when starting the motor, after which it is switched out and the other brought into circuit for continuous running. A field magnet is shown, the running winding of which is composed of four coils in conjunction with their usual starting coils, while the other winding is composed of eight coils together with their starting coils. The armature may be wound with a single winding having a resistance adapted to the running winding of the field magnet; or it may be wound with two windings, one of which is operative at starting and the other in continuous running. 4 claims.

15,011. "Improvements in brush-holders for dynamo electric machines." J. H. Yearsley. Dated June 22nd, 1897. Brush-holders.—The brush is contained in a box and is pressed against the commutator by a pair of arms pivoted to a bracket on the box, and united by a bridge-piece acted on by a spring. The tension of the spring can be adjusted by means of a screw with nuts. 2 claims.

15,238. "An improved manufacture of electrical resistances." J. F. Bachmann, A. Vogt, J. Kirchner, A. Konig, C. C. Weiner, and A. Jorg. Dated June 25th, 1897. Resistances are made of mixtures of powdered conducting and non-conducting or badly constructed materials, which may be rendered plastic or liquid and moulded or cast to any desired forms, and dried or baked, or may be used as powders. The conducting material may be formed in the baking by using decomposable ingredients, such as tar, sugar, or metallic compounds, or may be powdered metal or carbon. The other materials may be aluminia, gypsum, cement, clay, &c., and binding materials, such as water, glass, zinc, chloride, sugar, gum, &c. The resistances may be hardened with alum solution, and may be glazed or otherwise protected. Such resistances may be moulded in the form of receptacles which can be electrically heated for cooking or other purposes; the powders may be enclosed between a pot and an inner receptacle. 1 claim.

15,295. "Improvements in electric arc lamps." L. Bardon. Dated June 26th, 1897. Relates to lamps. The regulating mechanism of a brake lamp for continuous or alternating current at constant potential is shown. The carbon holders, of which the upper is the heavier, are hung by pulleys in loops of a cord; this is attached at one end to the top plate of the lamp, passes round three pulleys on fixed supports, and is attached at the other end to a pivoted regulating lever; the third pulley is attached to a brake-wheel. The lever is bent to carry cores over two shunt coils, and is linked to a counterweighted lever. The wheel is acted on by a brake lever when this is not raised by the action of the coils on the regulating lever and a contact piece linked to it. On starting the lamp the cores hold up the brake until the greater weight of the upper carbon holder places the carbons in contact; they then allow the lever to move so that the brake is applied and the lower carbon lowered, an arc being thus struck. 3 claims.

26,660. "An improved electric arc lamp." R. W. L. Holsten and the Elektrische Bogenlampenfabrik Naeck and Holsten Gesellschaft mit beschrankter Haftung. Dated November 15th, 1897. Relates to arc lamps.—A weighted upper-carbon-holder and a lower one, not shown, are suspended by a chain on a chain-wheel and a pulley. The wheel is geared to a rotary fly in a fixed frame and normally is prevented from rotating by contact of the fly with a finger, supported by a feed-lever which is pivoted and acted on by a spring. The pulley is carried by a striking lever pivoted at and acted on by a spring. The levers carry cores near a shunt solenoid. When current is supplied, the lower carbon is raised by the action of the core and pulley, and an arm of the lever tilts the finger so that the fly is released, and the carbons move together; they short-circuit the solenoid, which drops the core, so that the lower carbon strikes the arc. For continuous current, the solenoid and cores may be replaced by an electro-magnet and armatures. 1 claim.